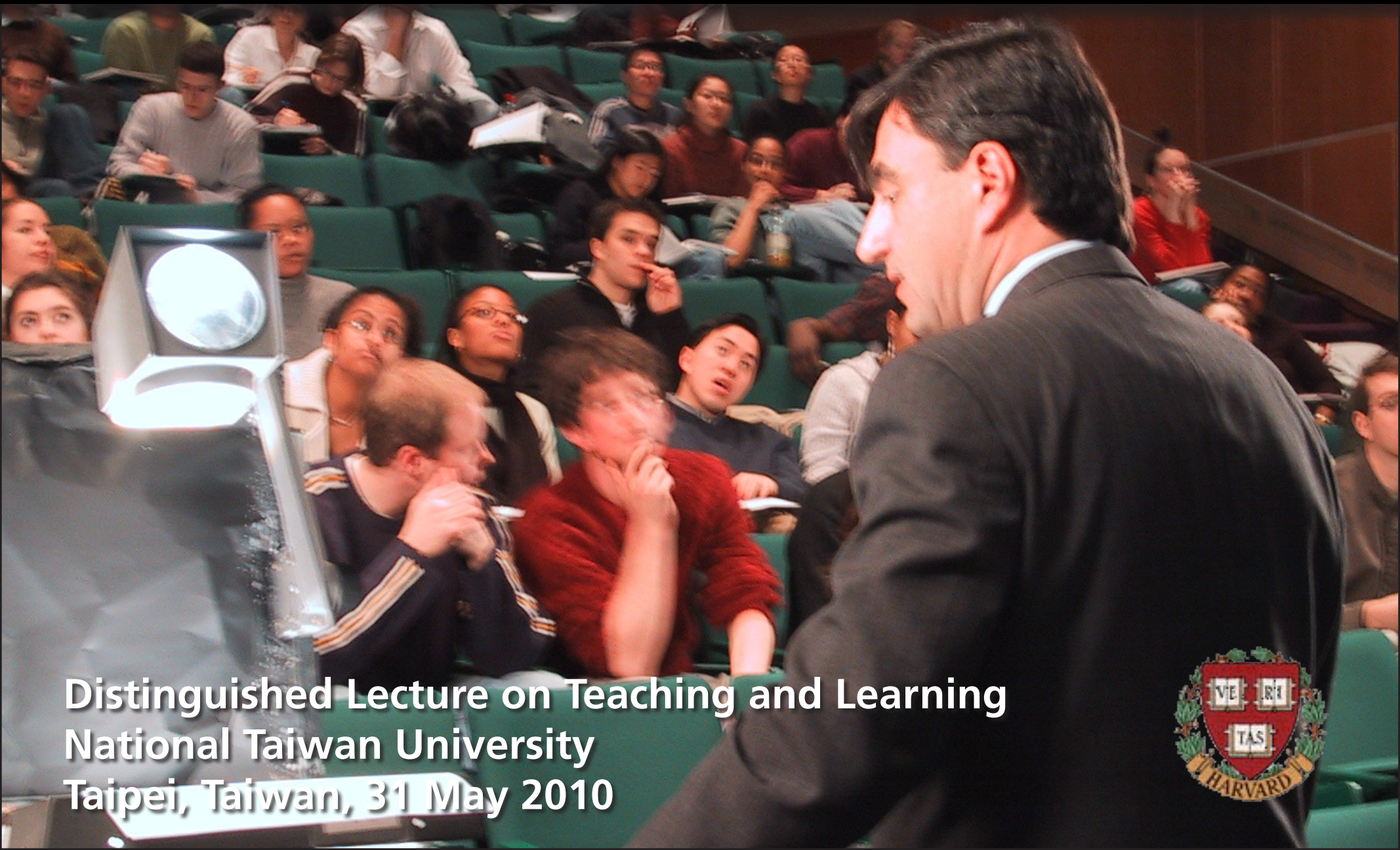
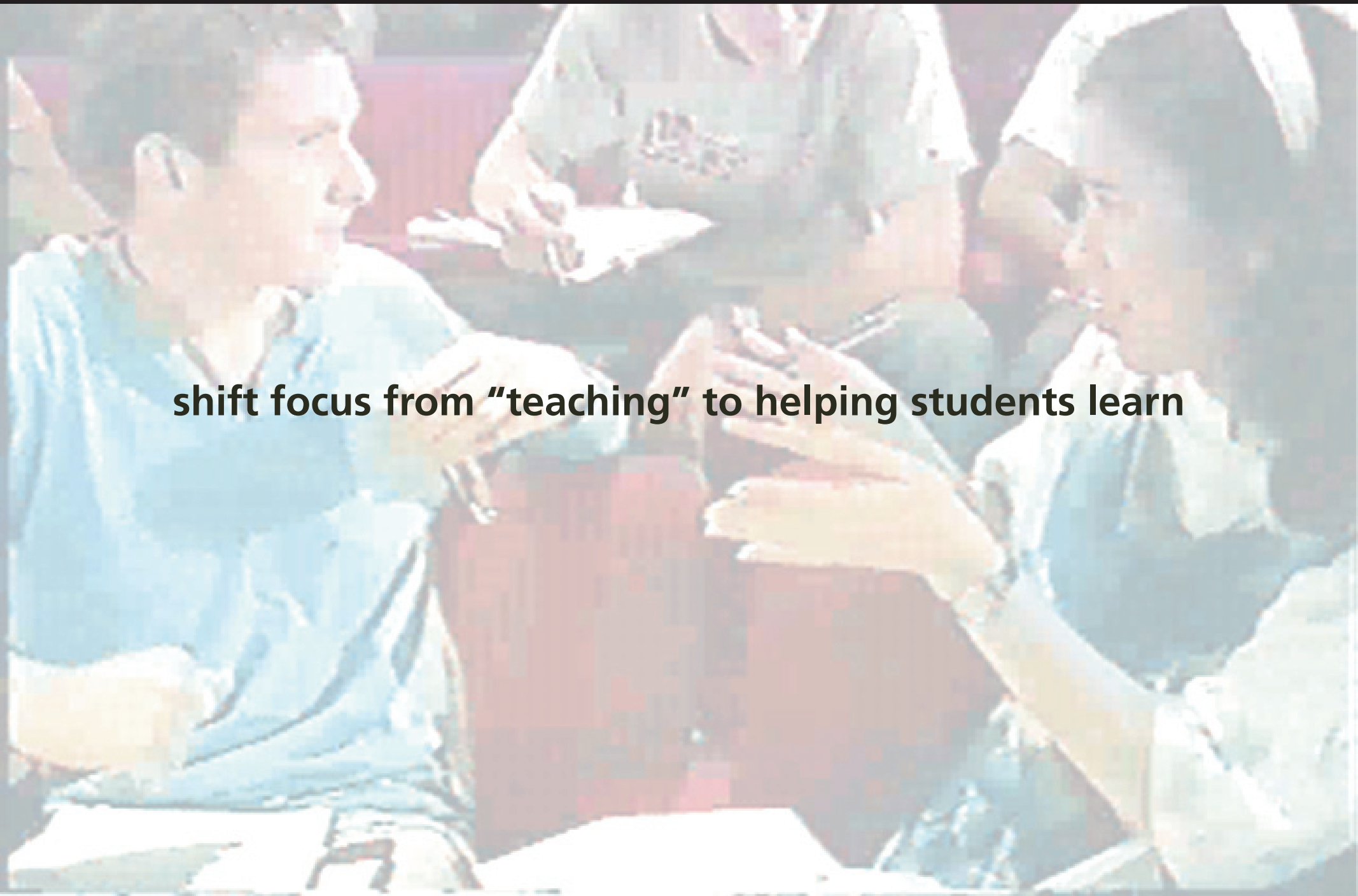
Confessions of a converted lecturer



Distinguished Lecture on Teaching and Learning
National Taiwan University
Taipei, Taiwan, 31 May 2010

My message



shift focus from “teaching” to helping students learn

Outline

- Education

Outline

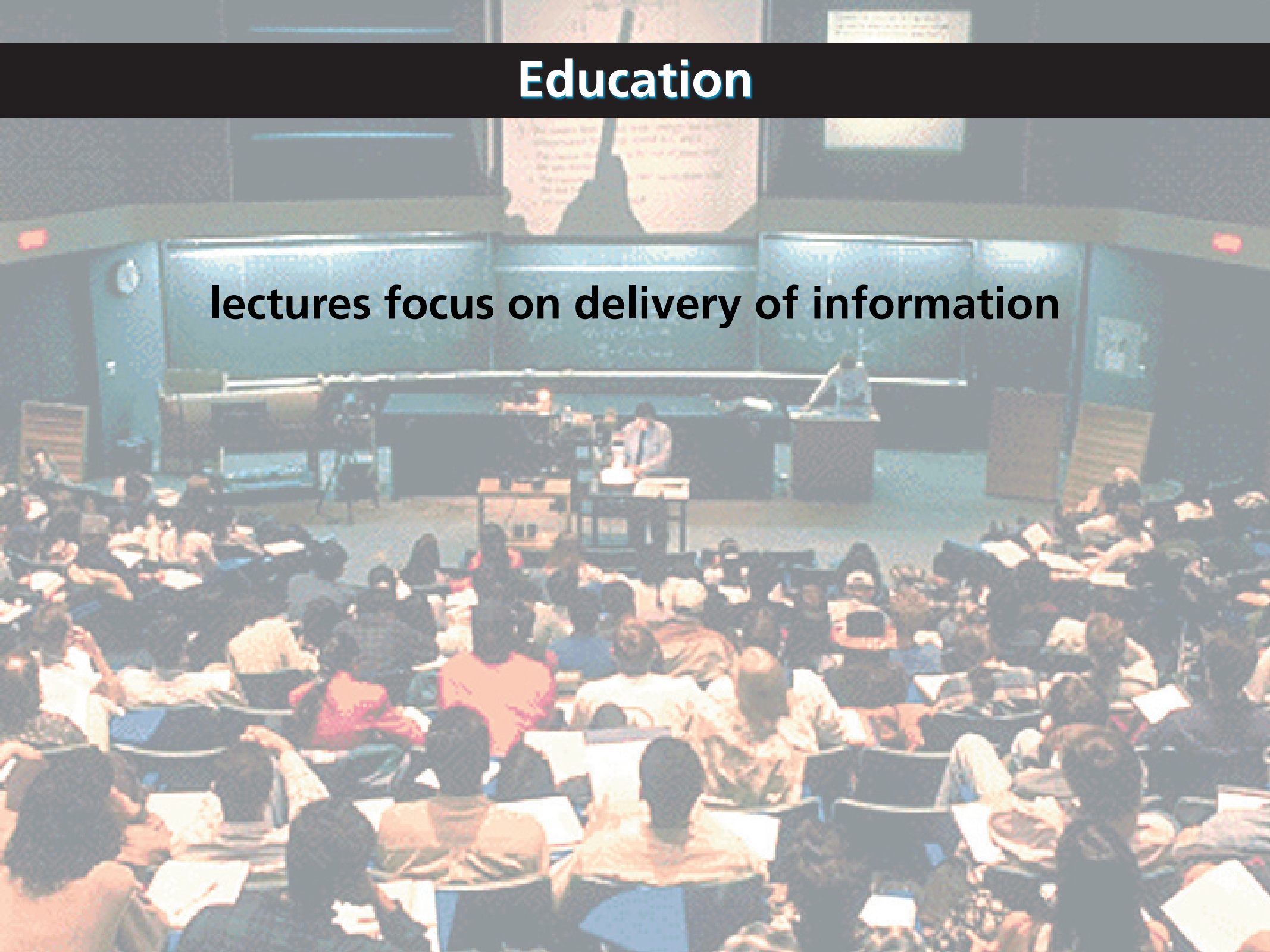
- Education
- Peer Instruction

Outline

- Education
- Peer Instruction
- Results

Education

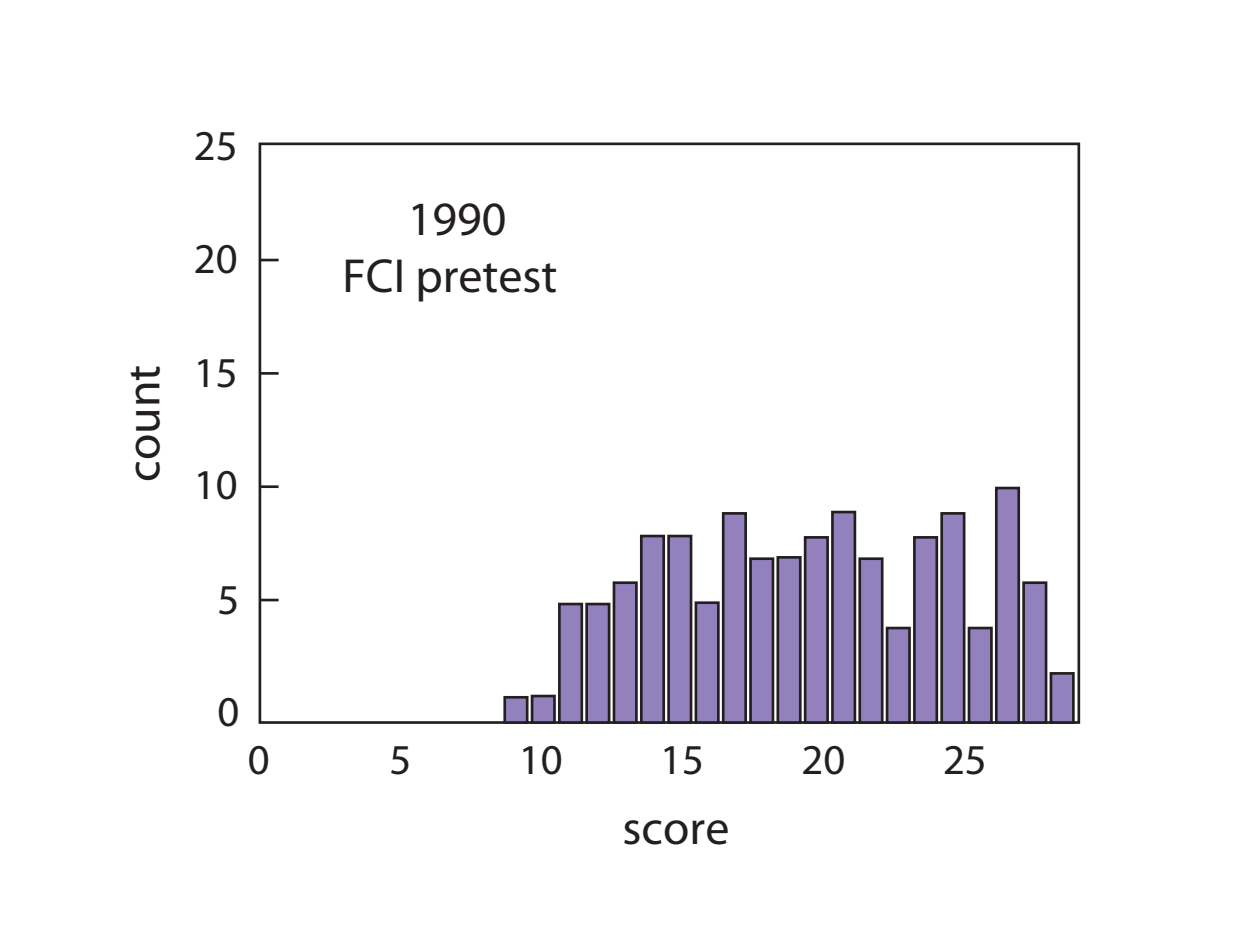
Education



lectures focus on delivery of information

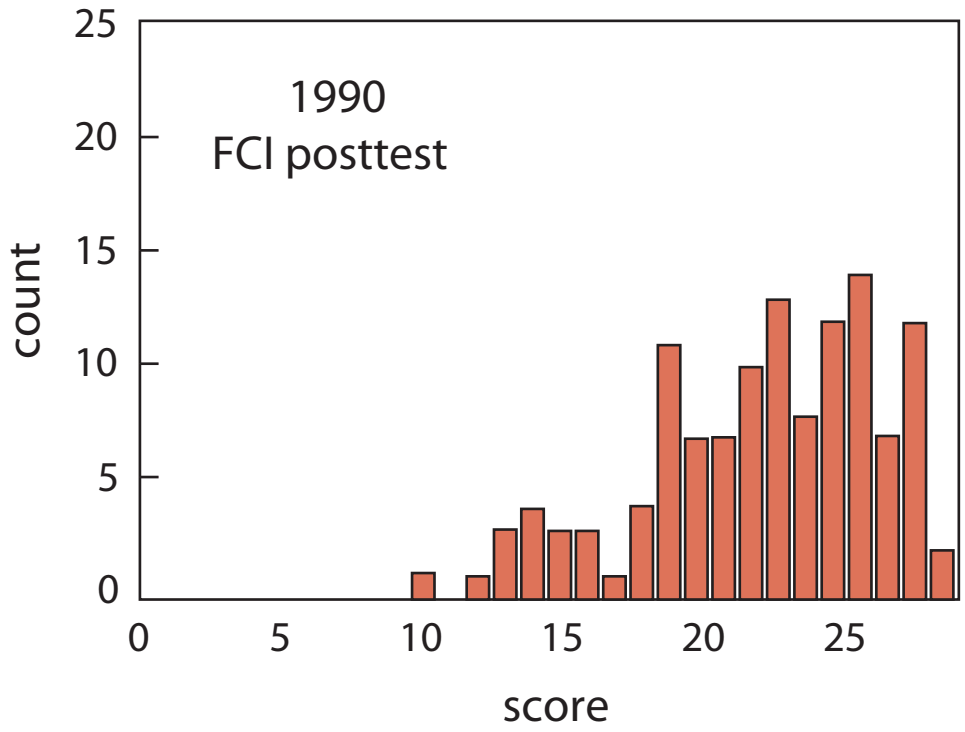
Education

education is not just information transfer



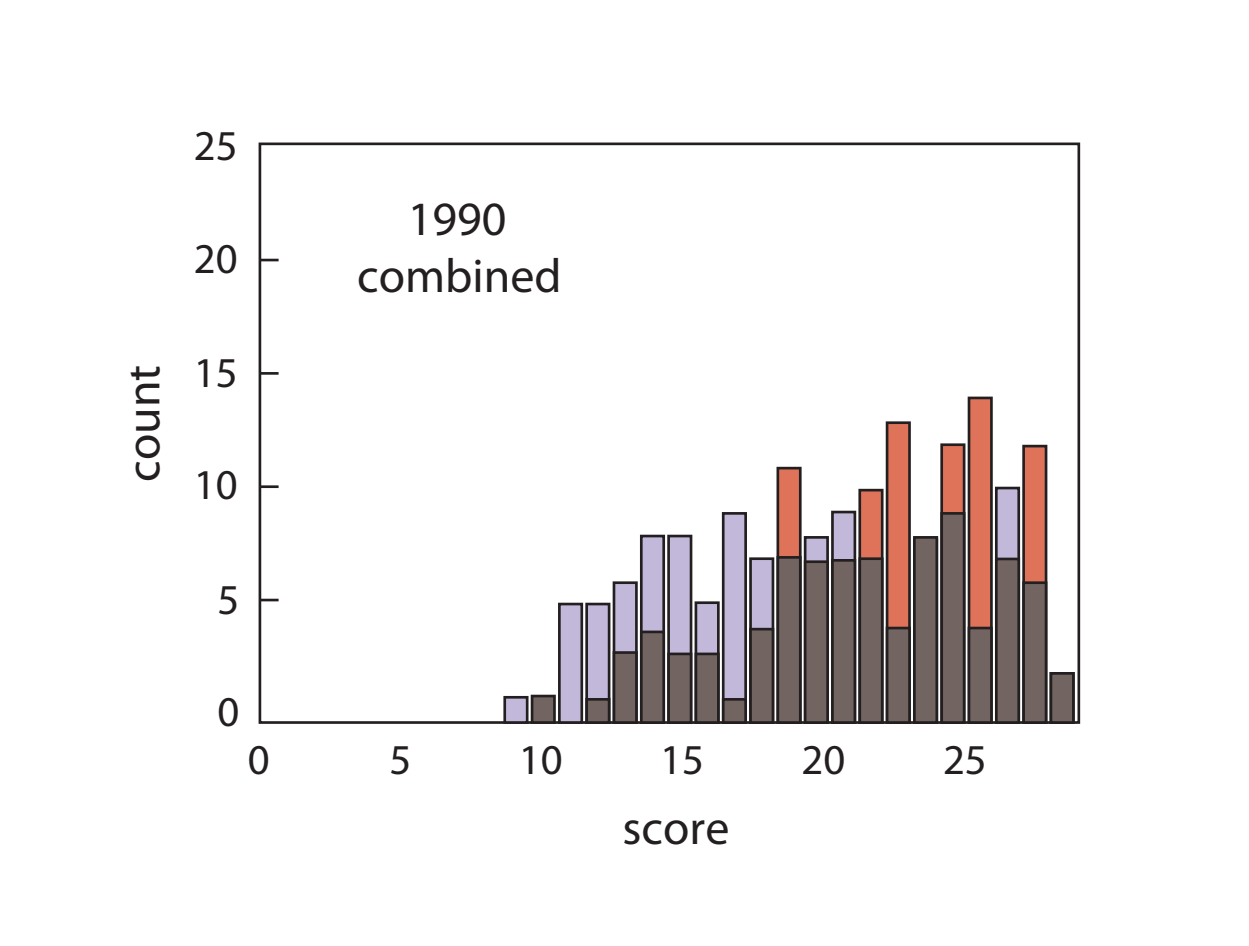
Education

education is not just information transfer

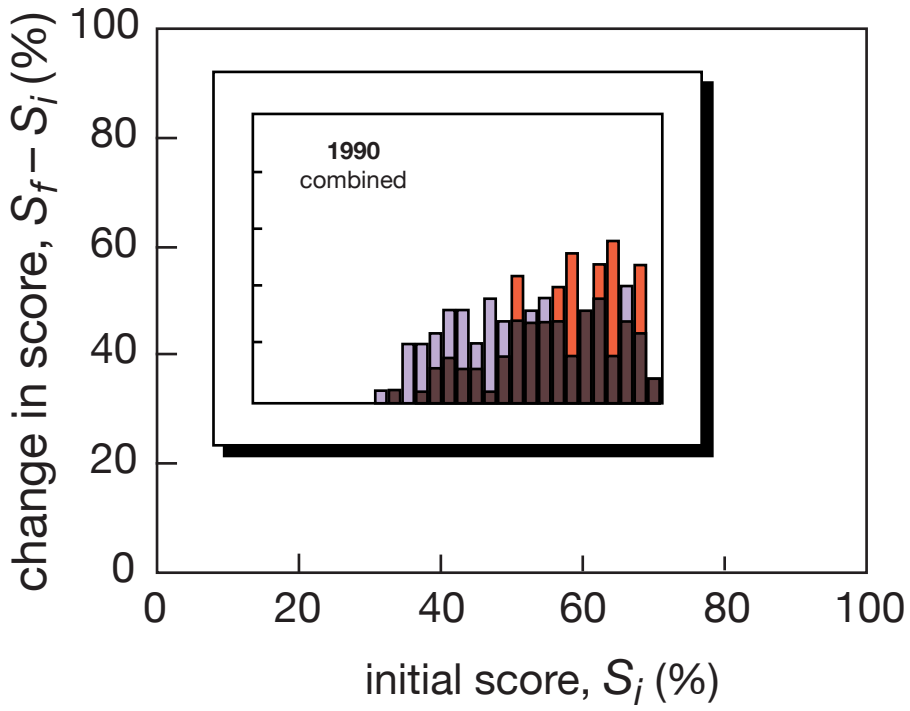


Education

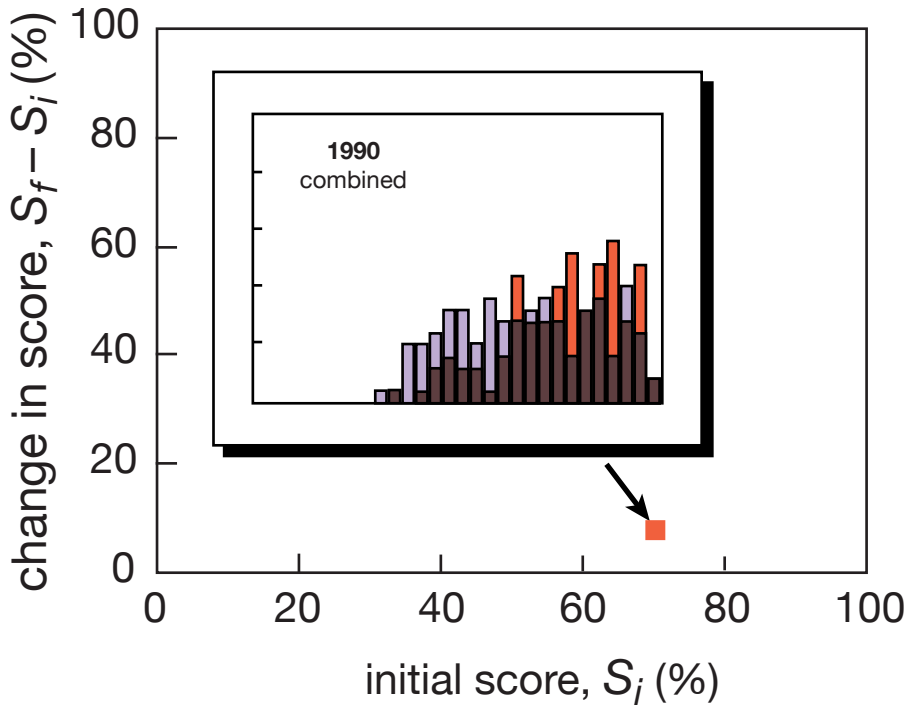
education is not just information transfer



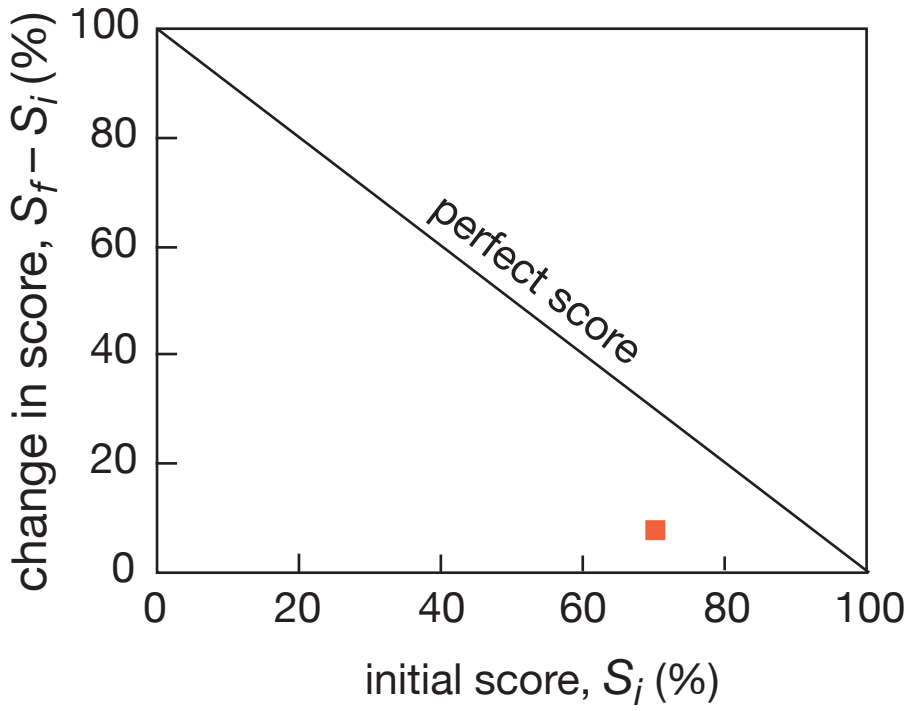
Education


1990
combined
change in score, $S_f - S_i$ (%)
initial score, S_i (%)
0
20
40
60
80
100

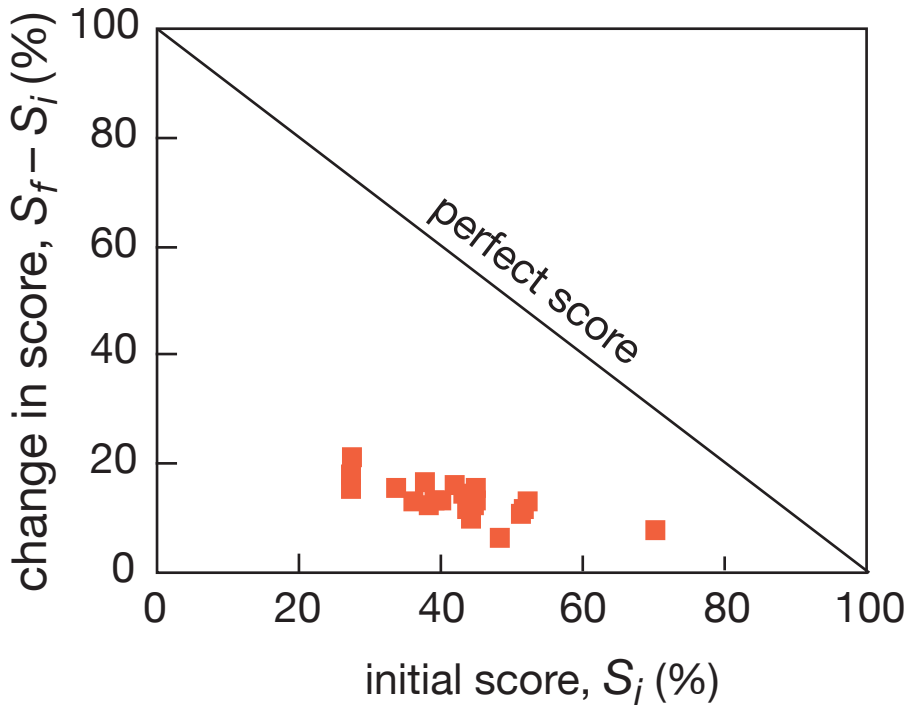
Education


1990
combined
change in score, $S_f - S_i$ (%)
initial score, S_i (%)
0
20
40
60
80
100

Education


100
80
60
40
20
0
0
20
40
60
80
100
perfect score
change in score, $S_f - S_i$ (%)
initial score, S_i (%)

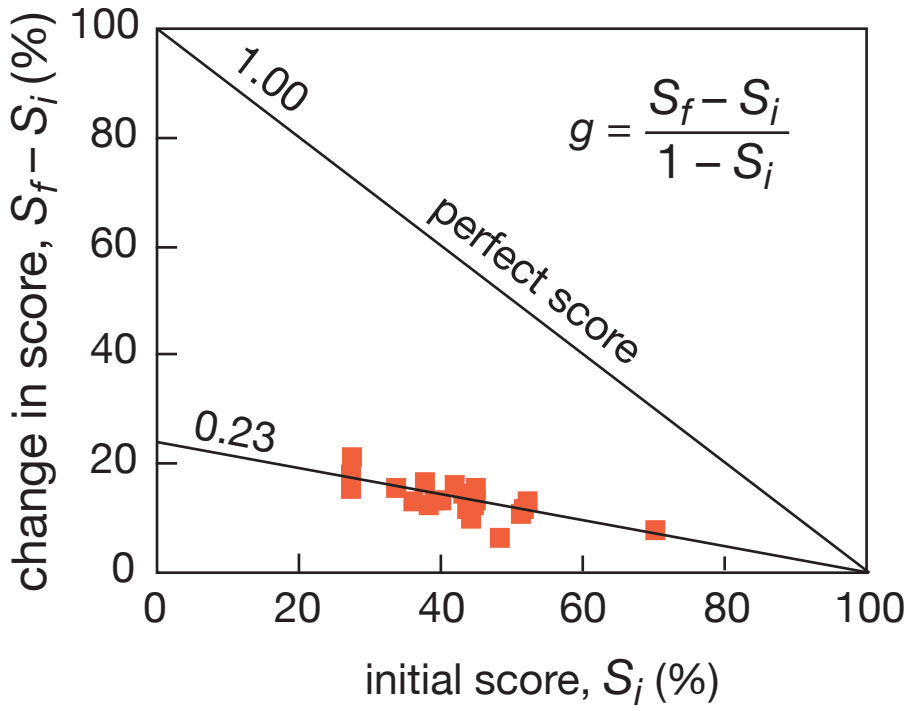
Education



R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

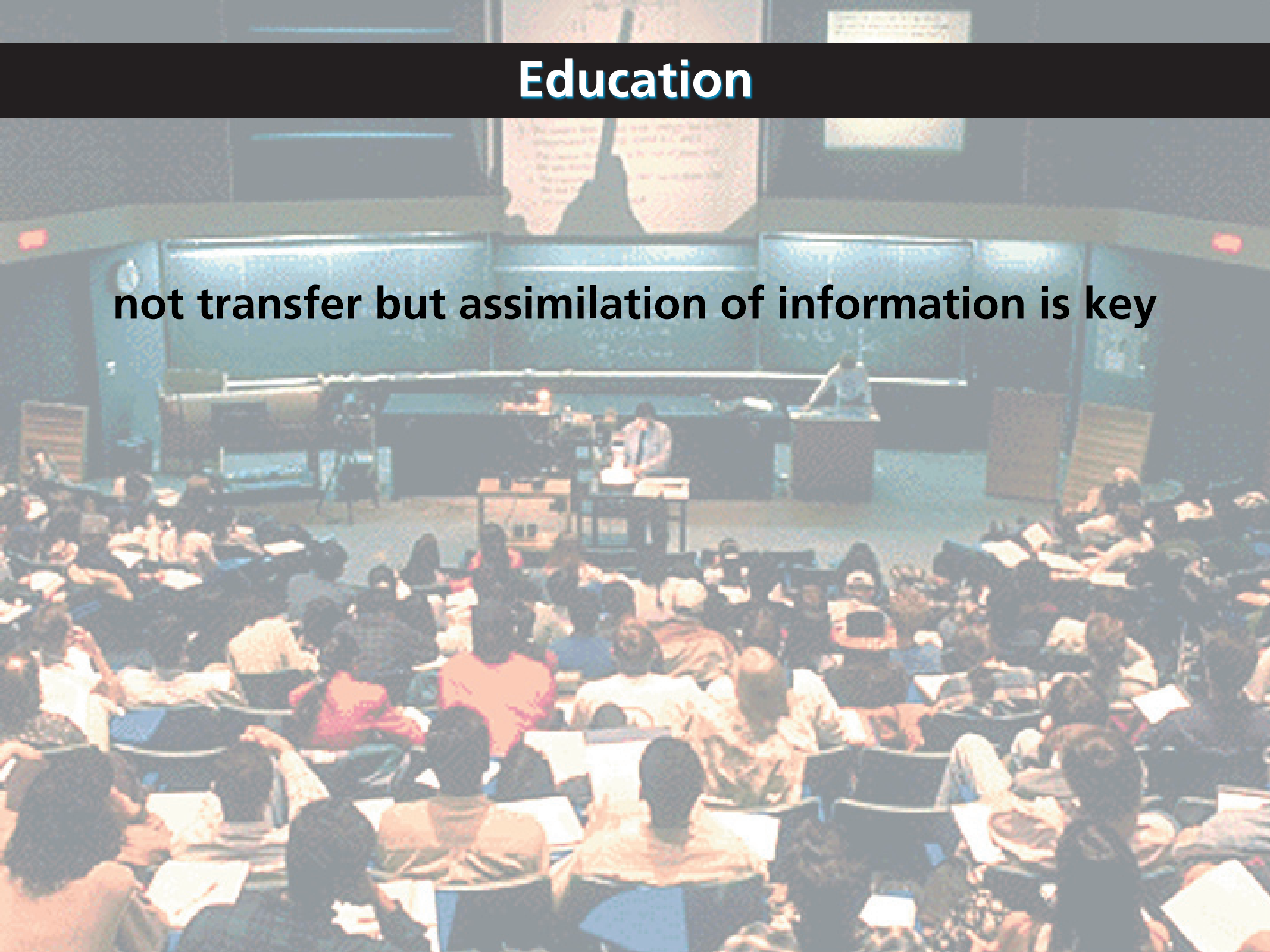
Education

only one quarter of maximum gain realized



R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

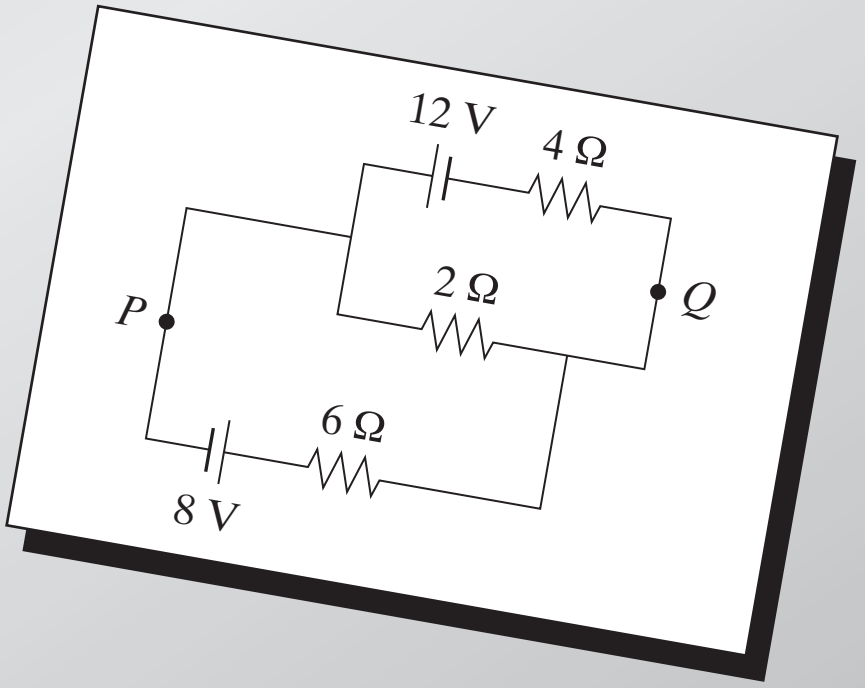
Education



not transfer but assimilation of information is key

Education

conventional problems misleading



Education

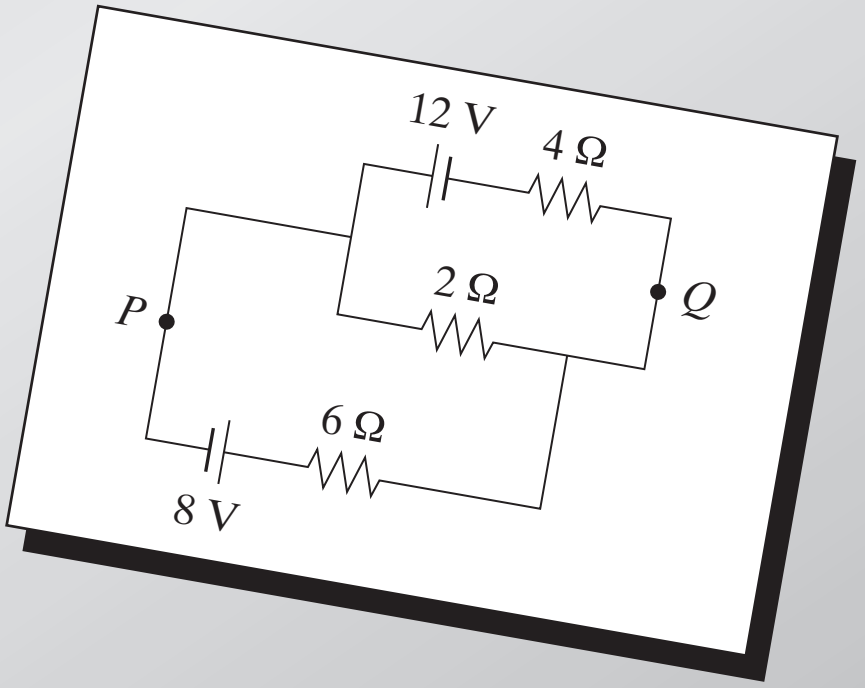
conventional problems misleading

Calculate:

(*a*) current in 2-Ω resistor

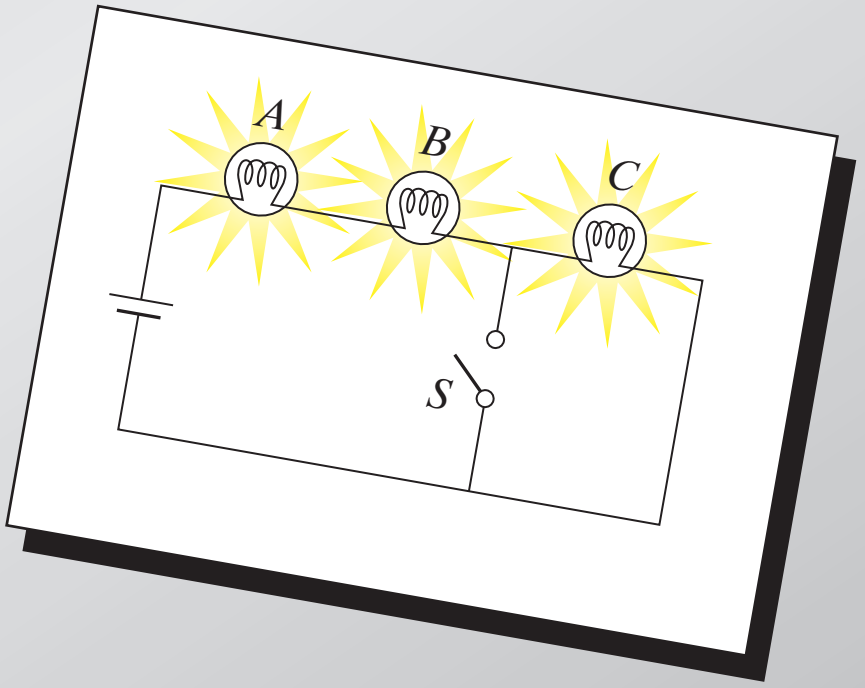
(*b*) potential difference

between *P* and *Q*



Education

are the basic principles understood?



Education

are the basic principles understood?

When *S* is closed, what happens to:

(*a*) intensities of A and B?

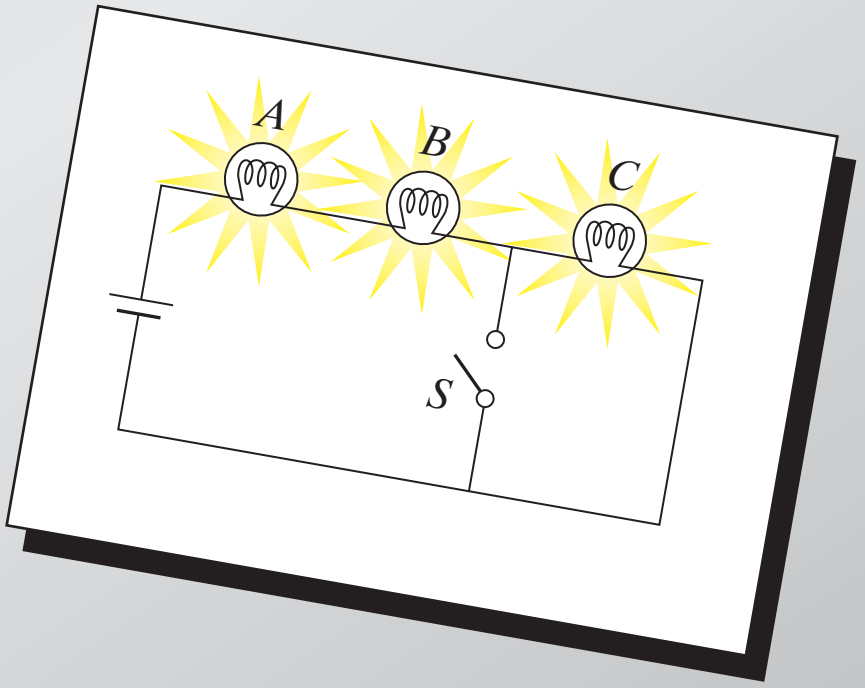
(*b*) intensity of C?

(*c*) current through battery?

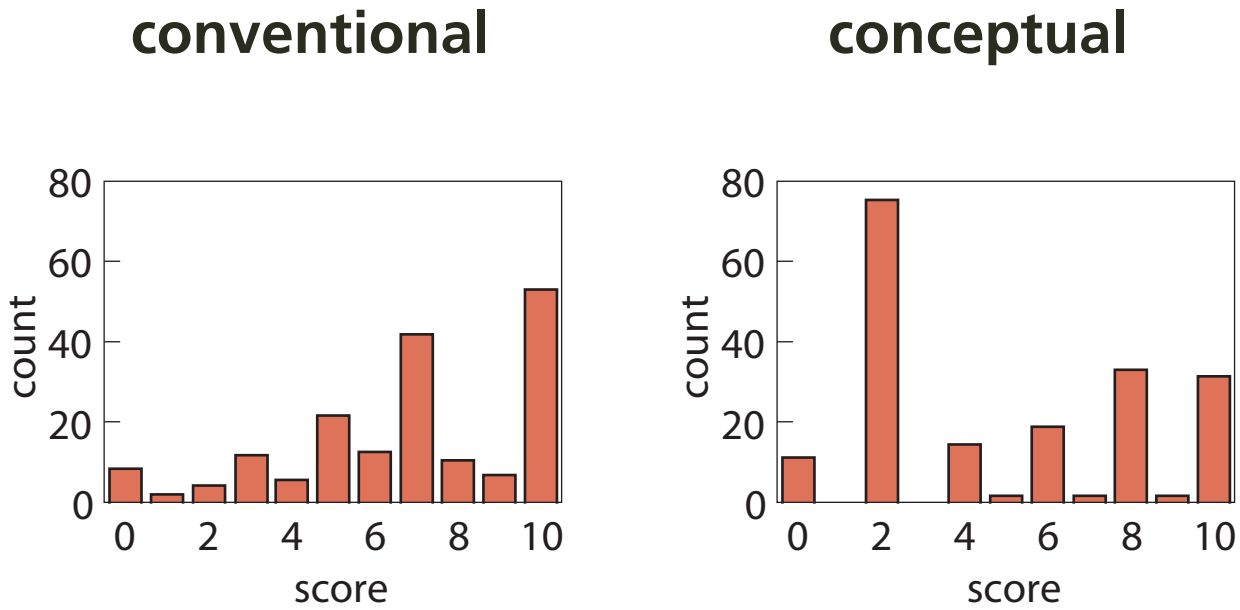
(*d*) potential difference across

A, *B*, and *C*?

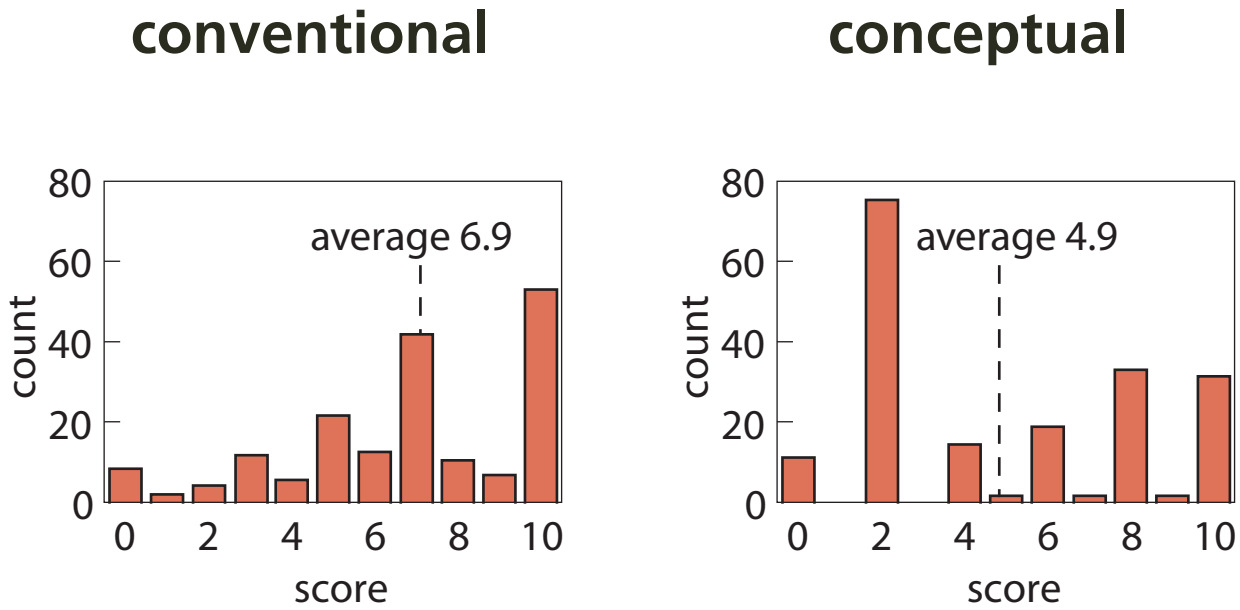
(*e*) the total power dissipated?



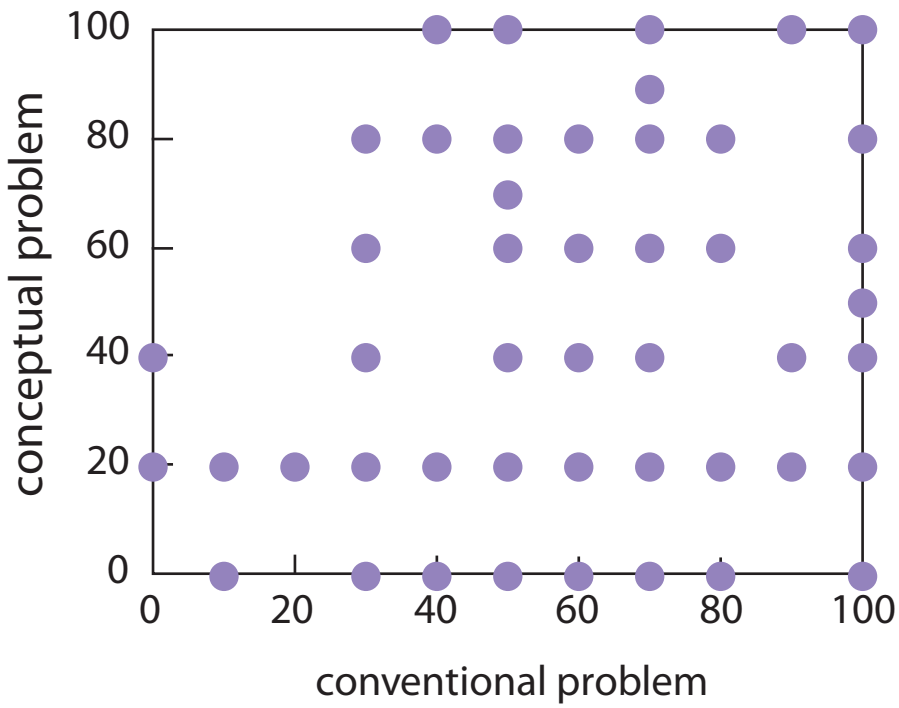
Education



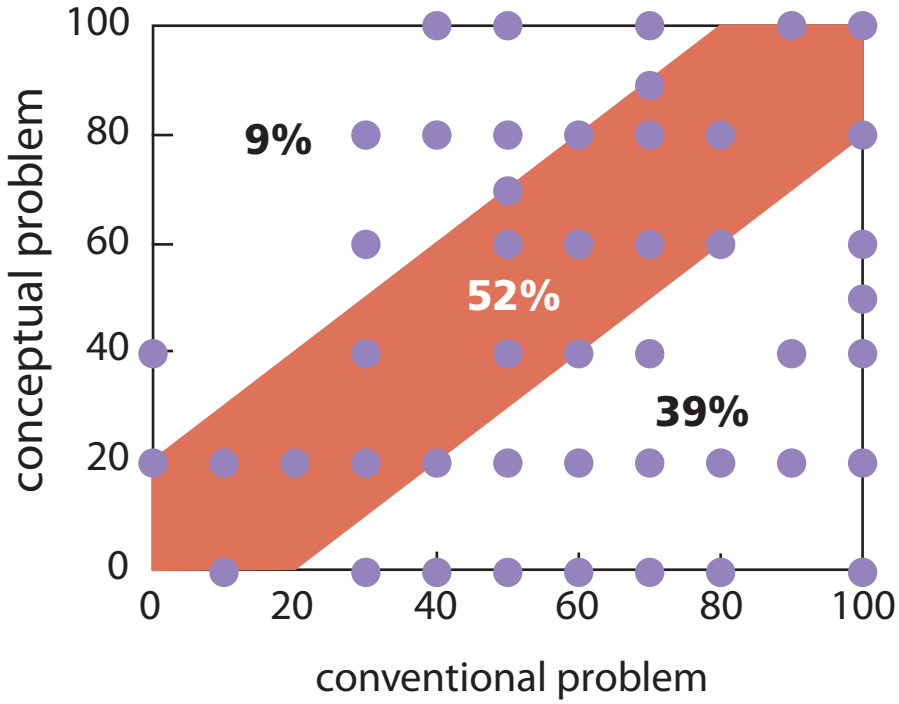
Education


conventional
conceptual
average 6.9
average 4.9
count
score
0
20
40
60
80
0
2
4
6
8
10

Education


100
80
60
40
20
0
conceptual problem
0
20
40
60
80
100
conventional problem

Education


100
80
60
40
20
0
conceptual problem
9%
52%
39%
0
20
40
60
80
100
conventional problem


So what should we do?

Peer Instruction

Give students more responsibility for gathering information…

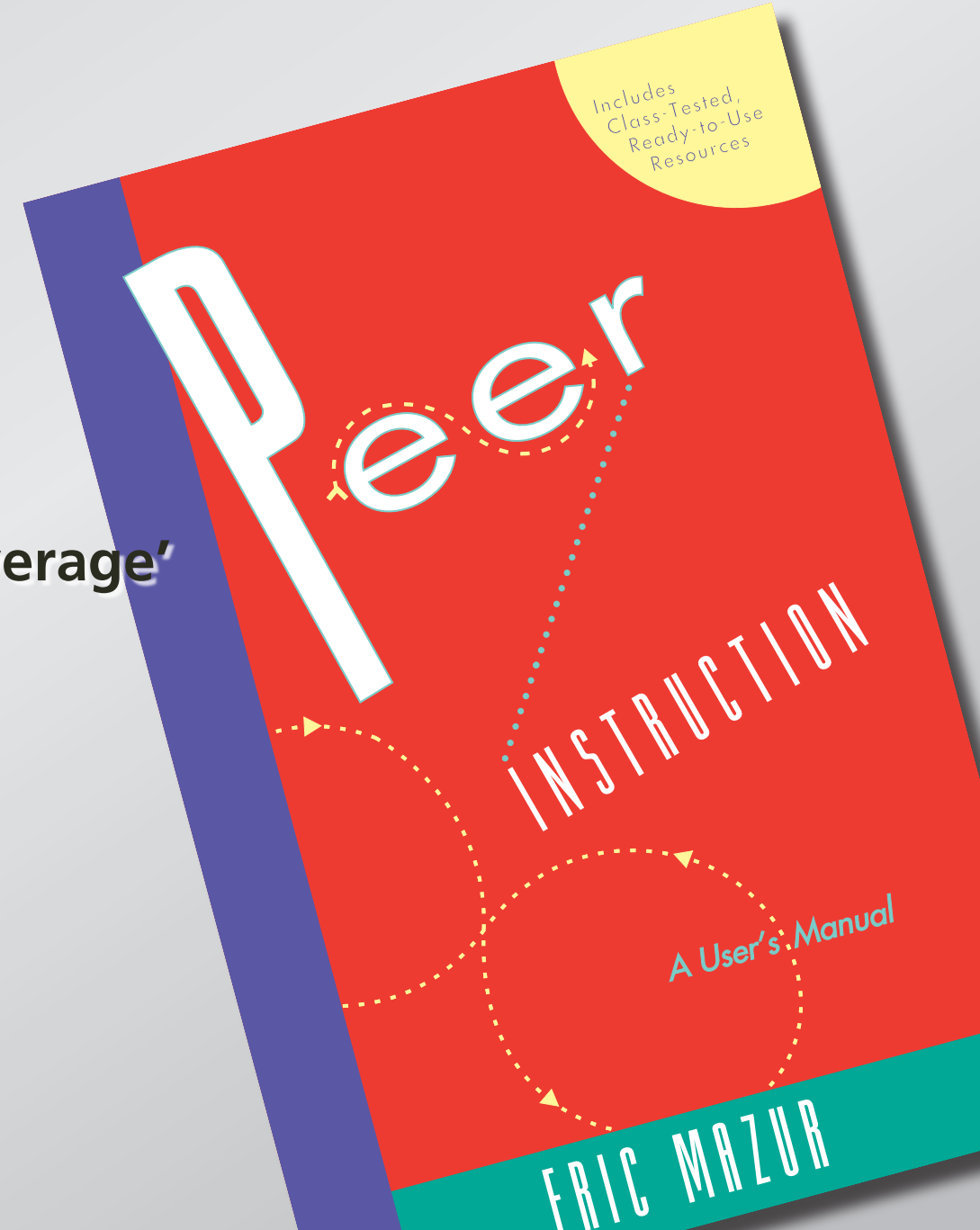
Peer Instruction

Give students more responsibility for gathering information…
so we can better help them assimilate it.

Peer Instruction

Main features:

- pre-class reading
- in-class: depth, not ‘coverage’
- ConcepTests



Peer Instruction

ConcepTest:

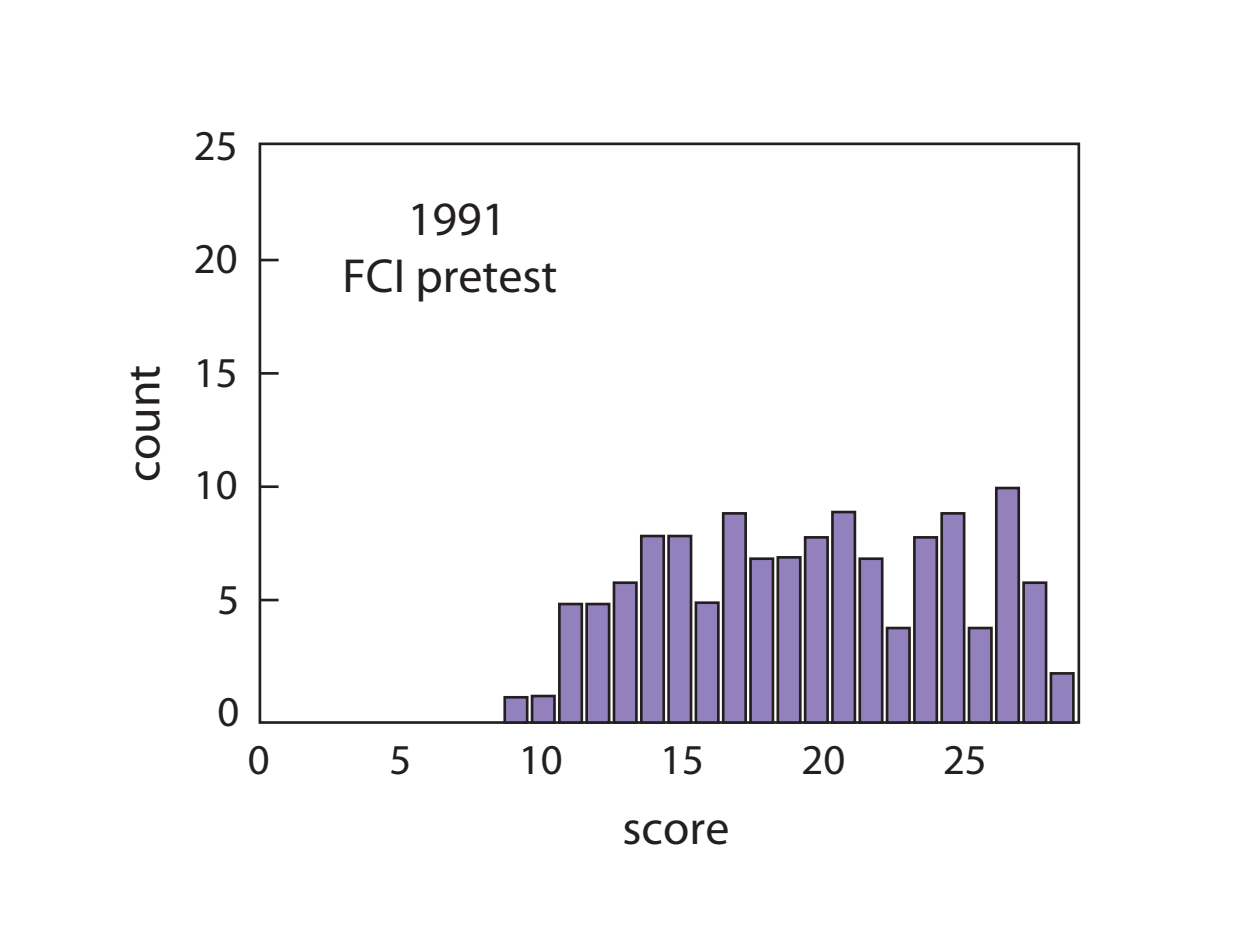
1. Question
2. Thinking
3. Individual answer
4. Peer discussion
5. Revised/Group answer
6. Explanation

Results

is it any good?

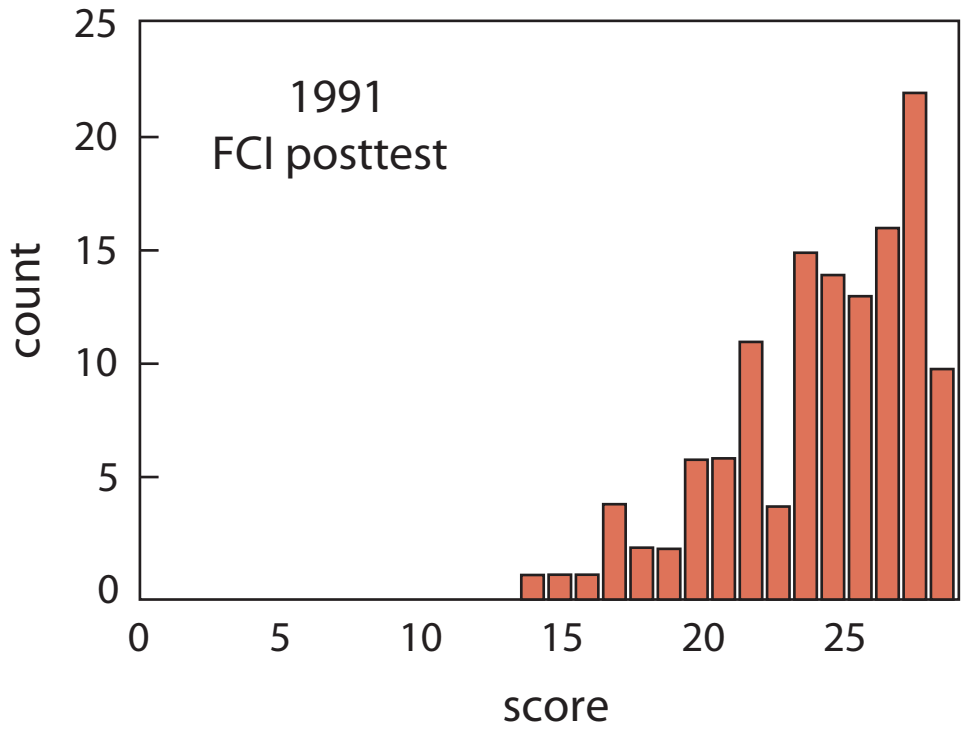
Results

first year of implementing PI



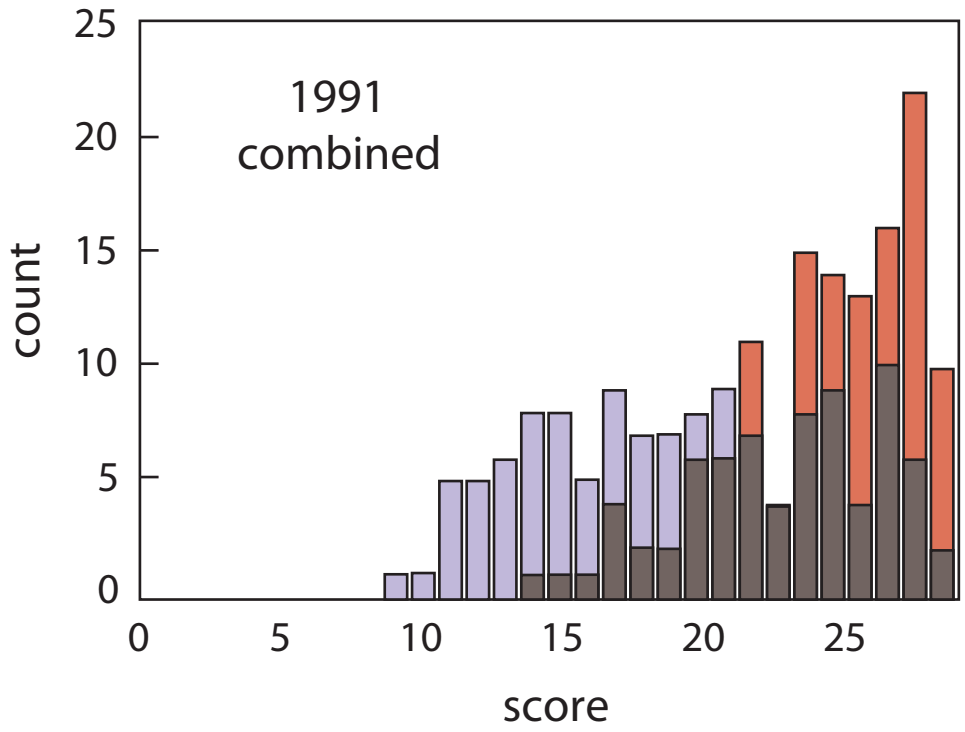
Results

first year of implementing PI

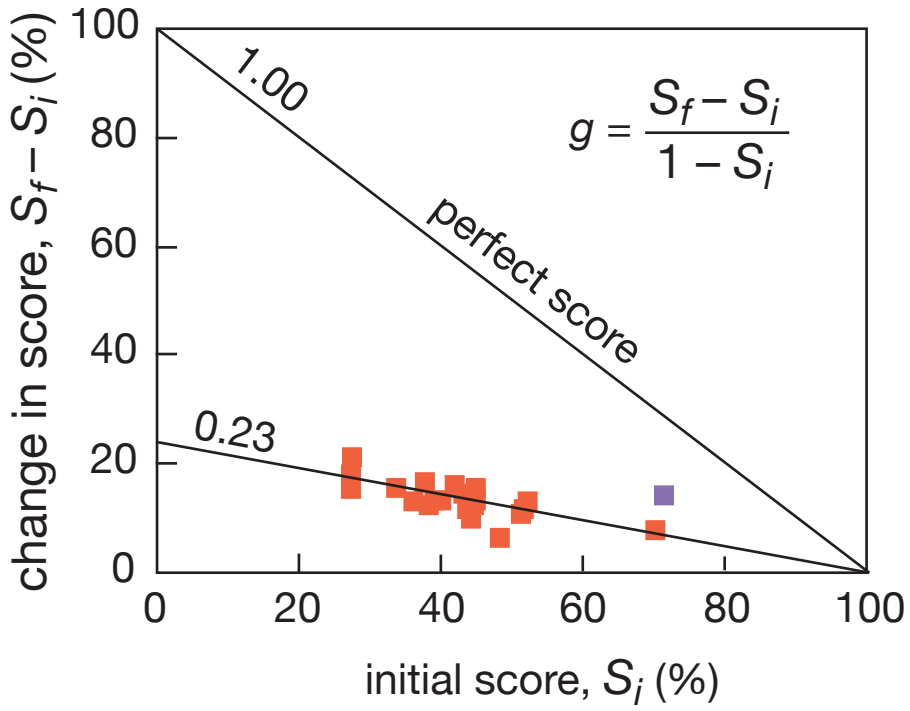


Results

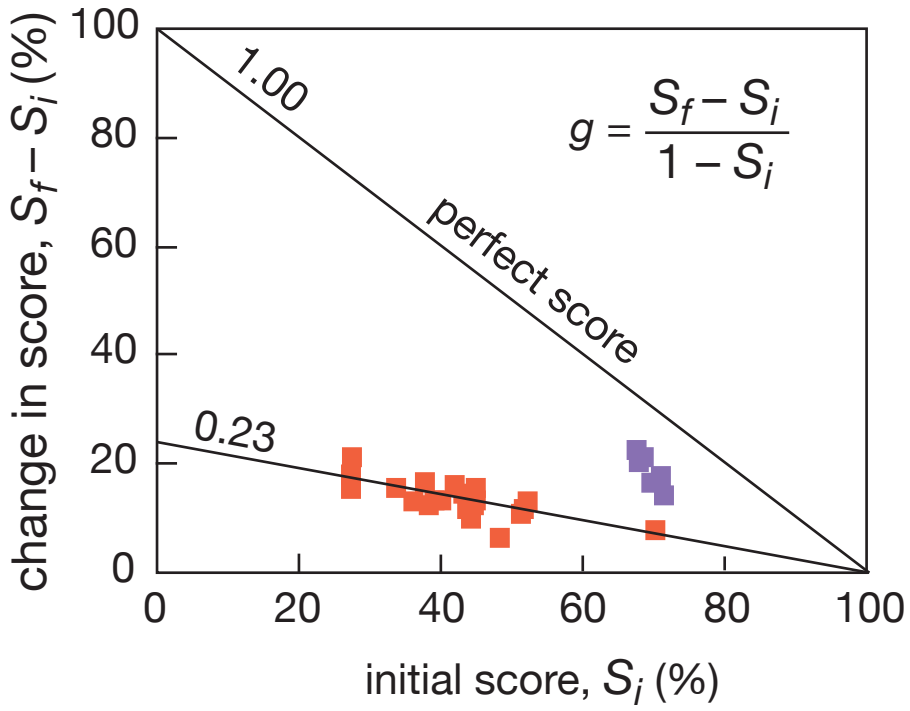
first year of implementing PI



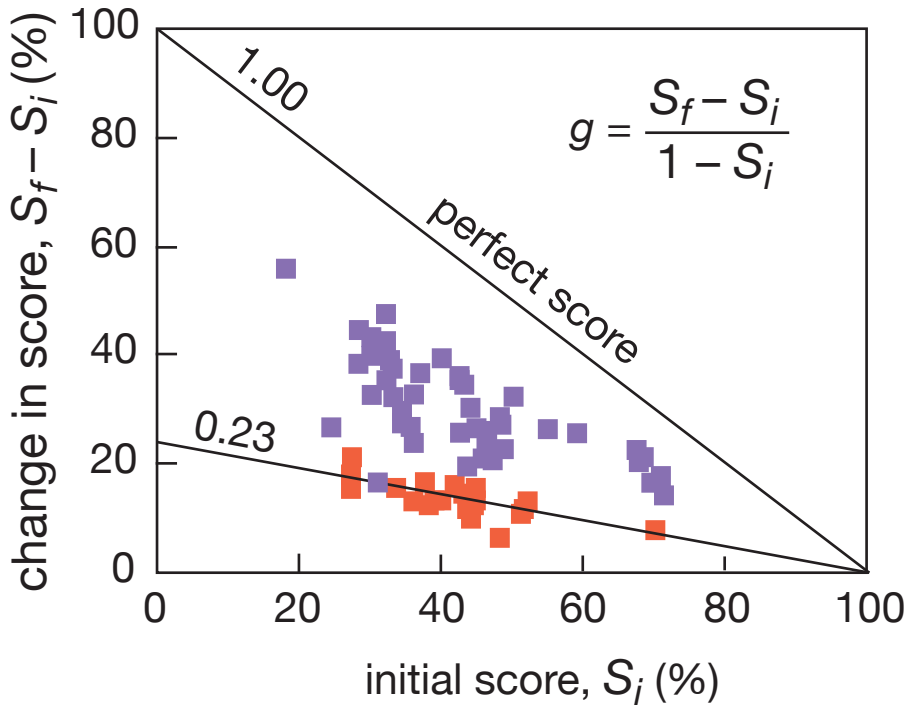
Results


100
80
60
40
20
0
0
20
40
60
80
100
1.00
perfect score
0.23
$g = \frac{S_f - S_i}{1 - S_i}$
change in score, $S_f - S_i$ (%)
initial score, S_i (%)

Results

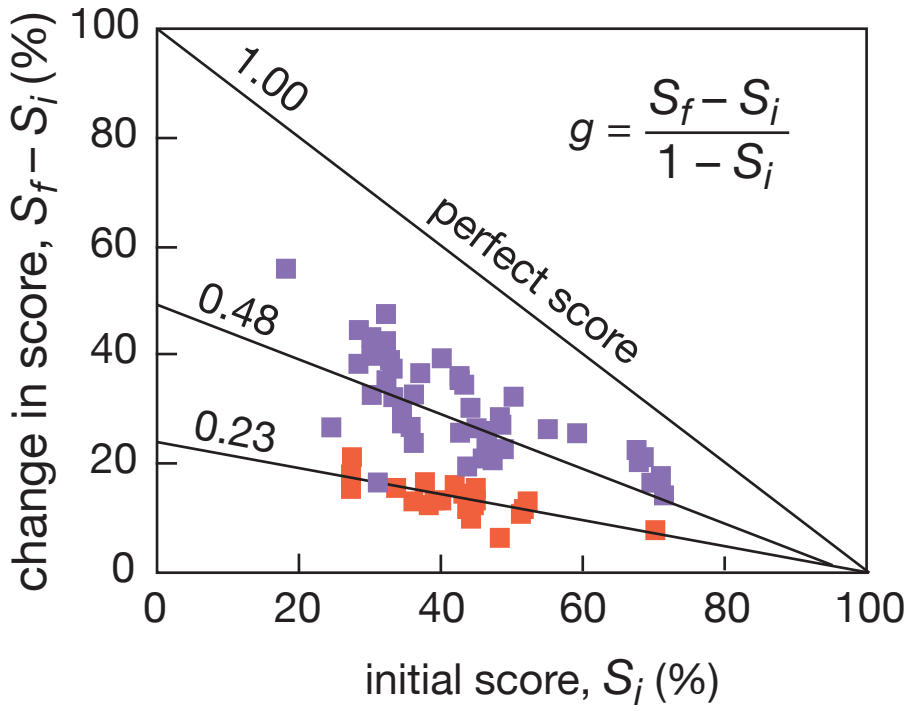

100
80
60
40
20
0
0
20
40
60
80
100
1.00
perfect score
0.23
$g = \frac{S_f - S_i}{1 - S_i}$
change in score, $S_f - S_i$ (%)
initial score, S_i (%)

Results



R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

Results

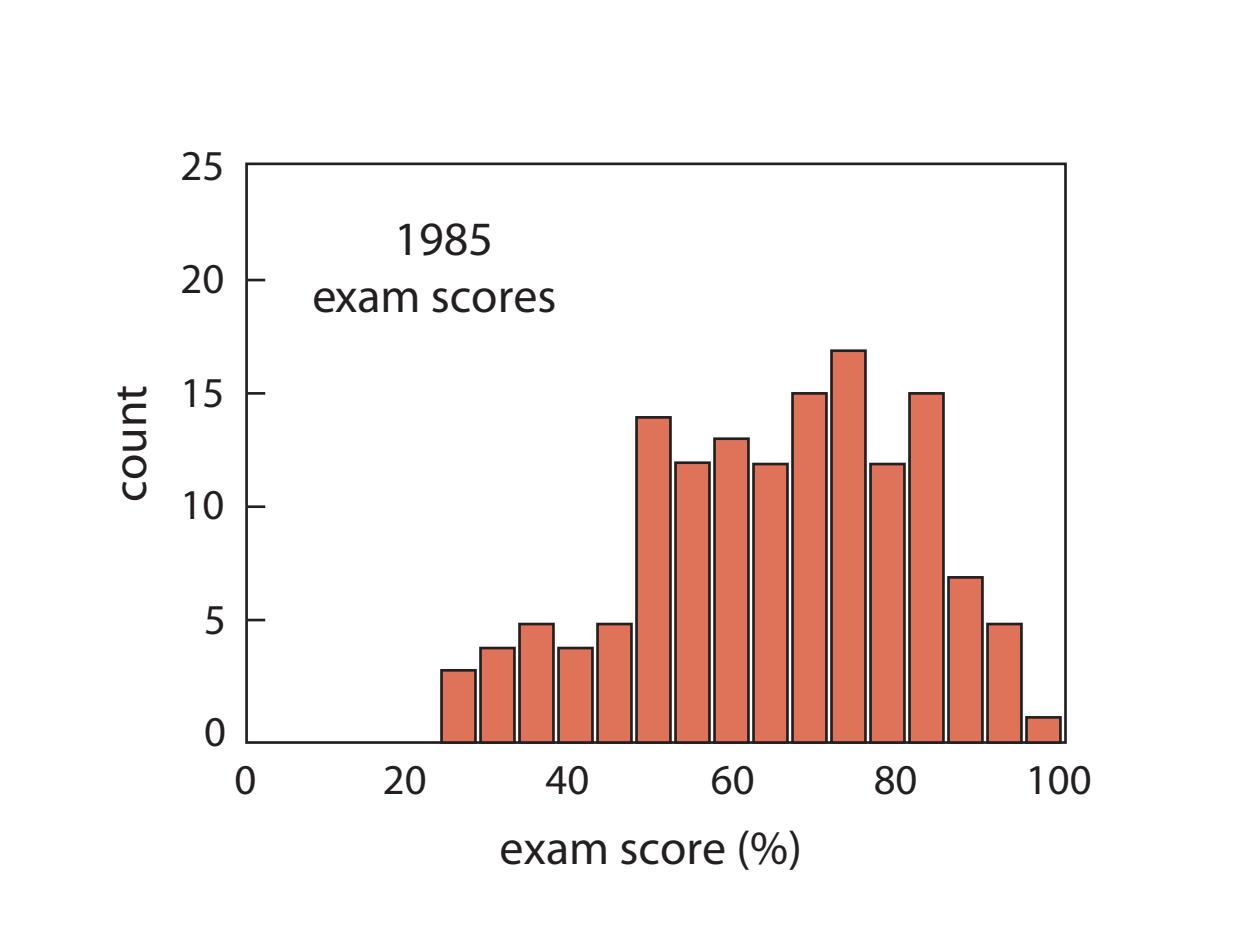


R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

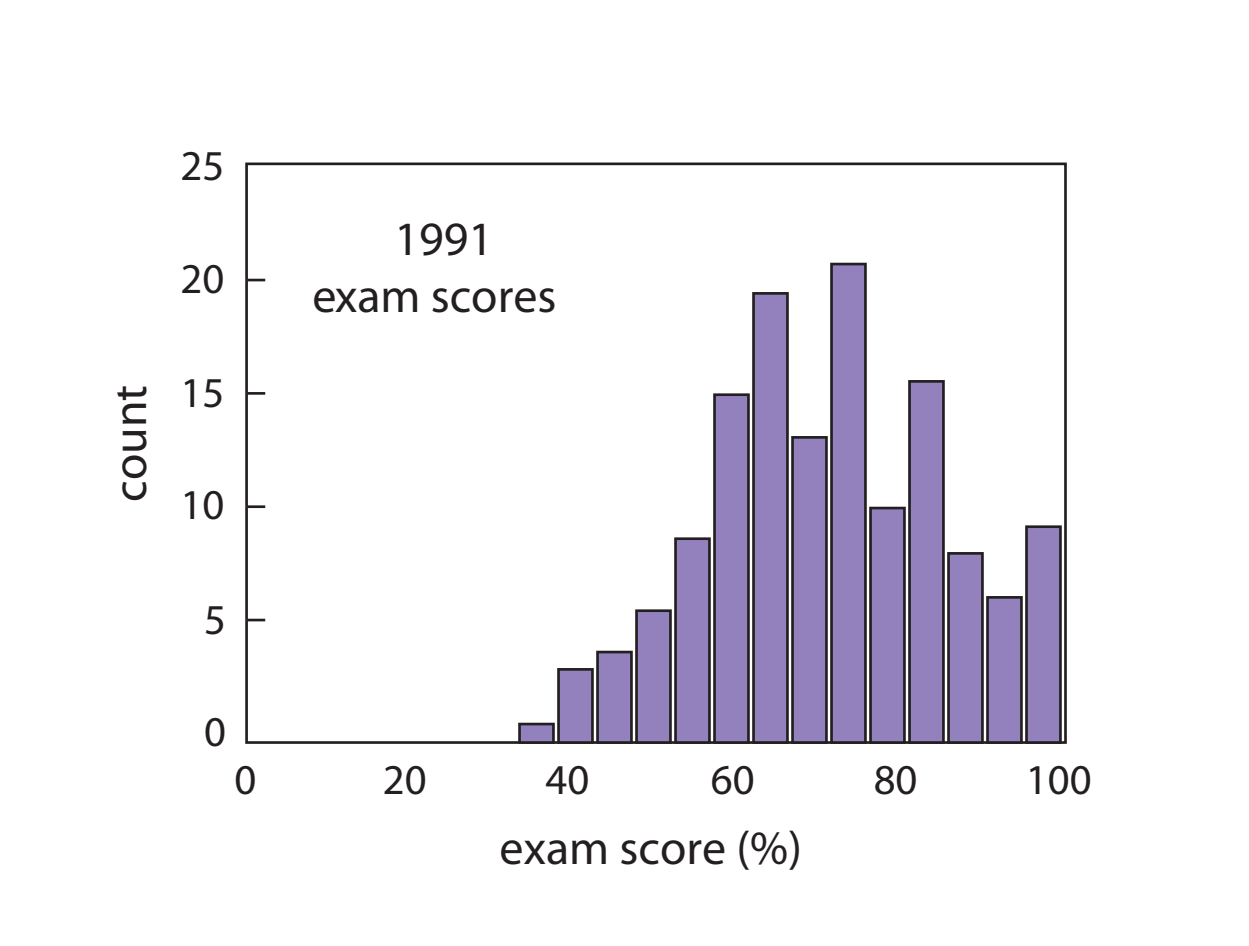
Results

what about problem solving?

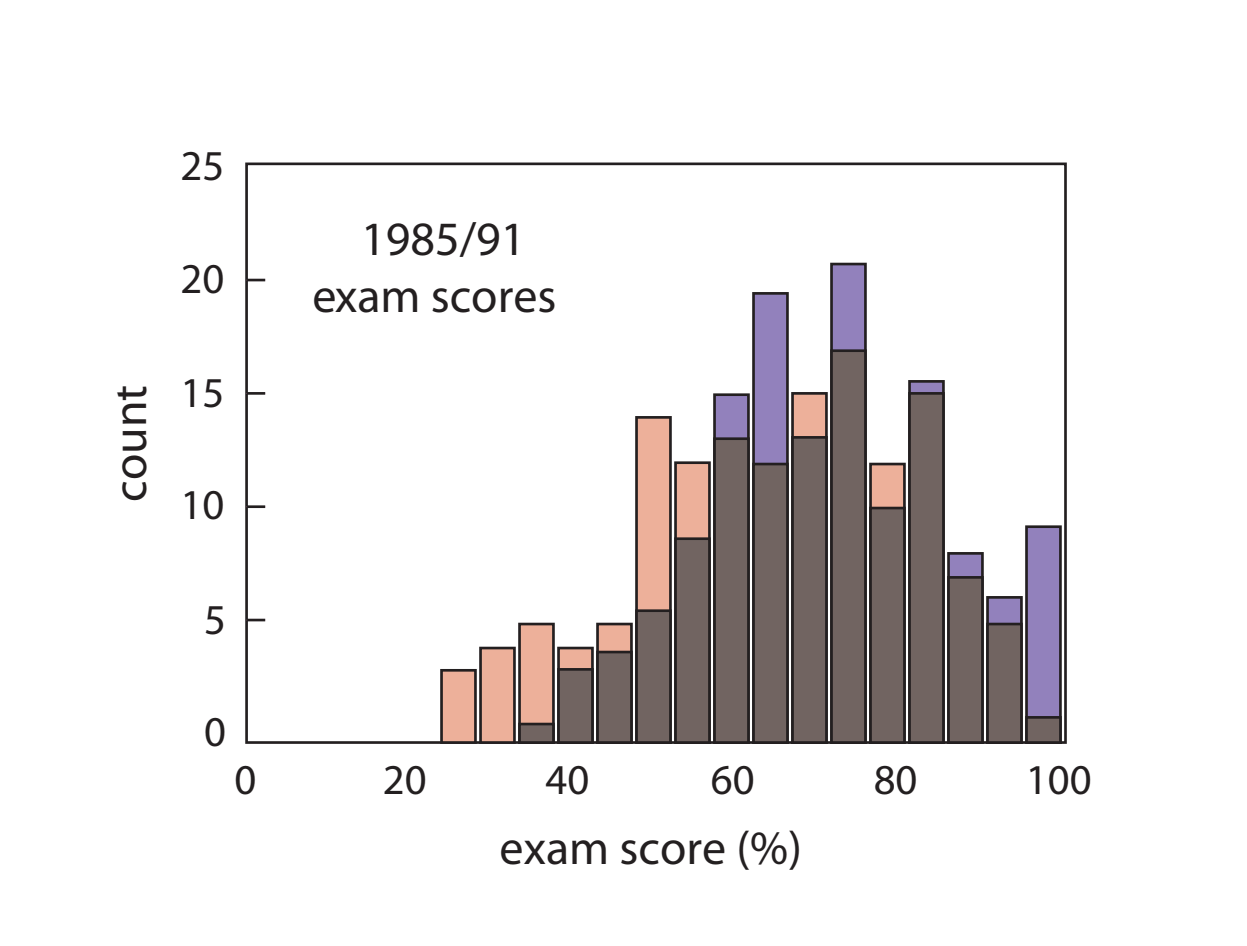
Results


1985
exam scores
count
25
20
15
10
5
0
0
20
40
60
80
100
exam score (%)

Results


1991
exam scores
count
25
20
15
10
5
0
0
20
40
60
80
100
exam score (%)

Results


1985/91
exam scores
count
25
20
15
10
5
0
0
20
40
60
80
100
exam score (%)

Summary

So better understanding leads to better problem solving!

Summary

So better understanding leads to better problem solving!

(but “good” problem solving doesn’t always indicate understanding!)

Summary

Traditional indicators of success misleading

Summary

Traditional indicators of success misleading

Education is no longer about information

Funding:

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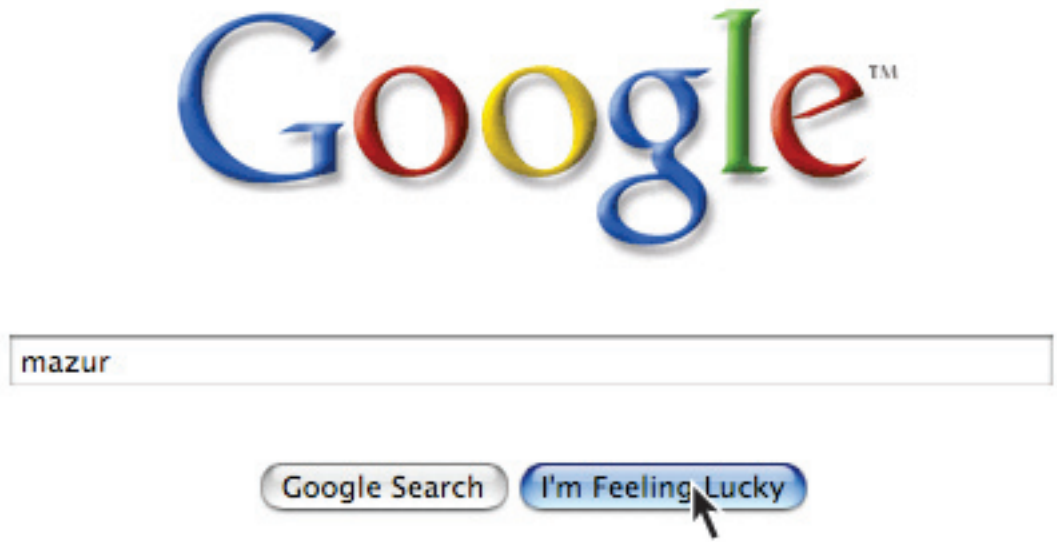
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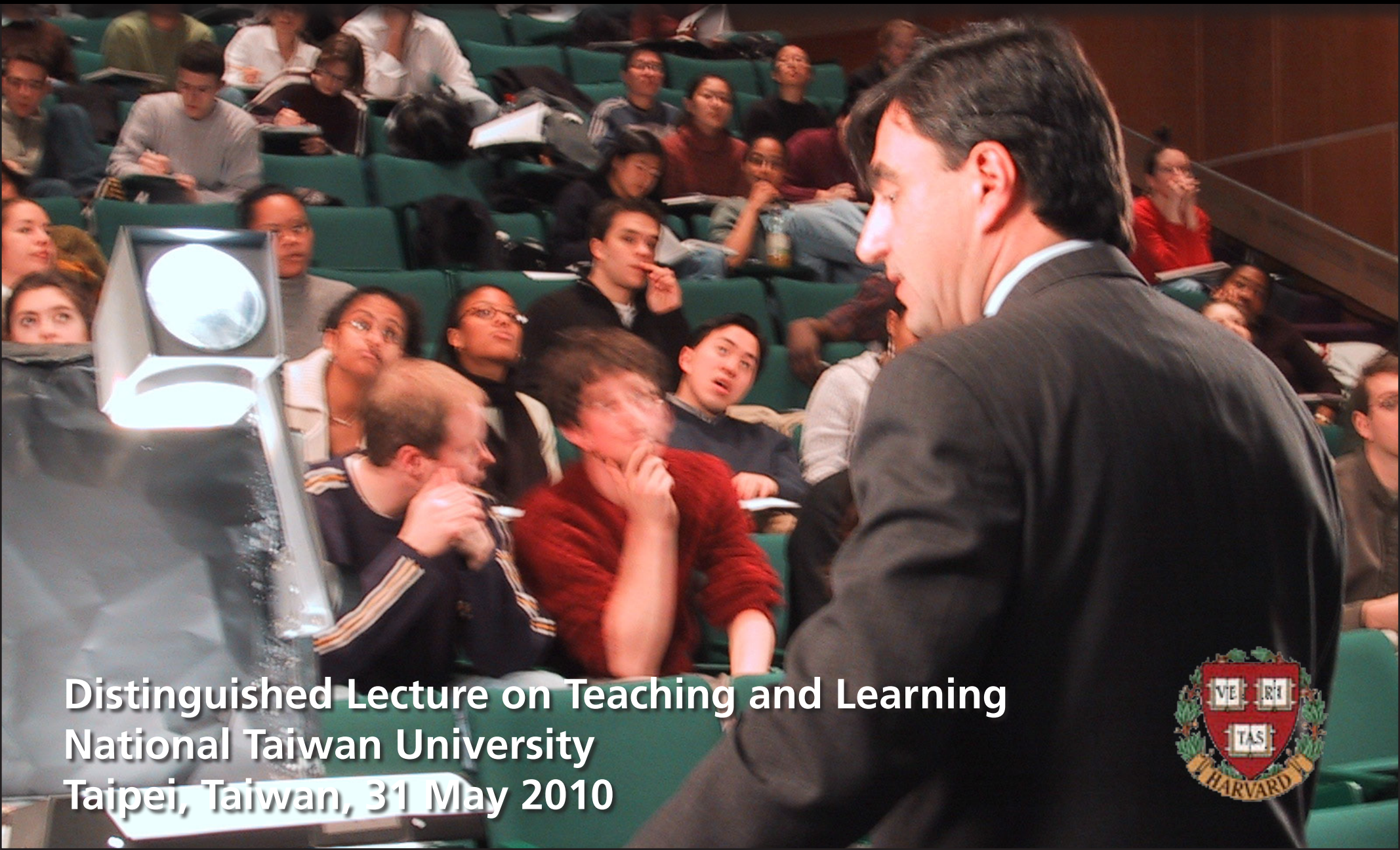
Confessions of a converted lecturer

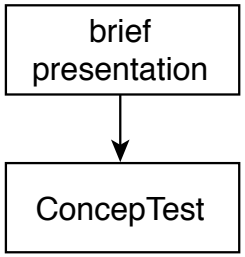


Distinguished Lecture on Teaching and Learning
National Taiwan University
Taipei, Taiwan, 31 May 2010

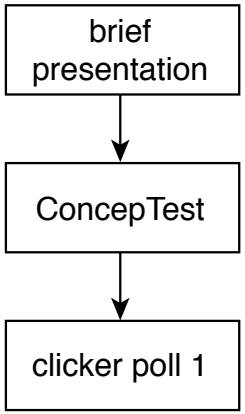
Peer Instruction: a primer

brief
presentation

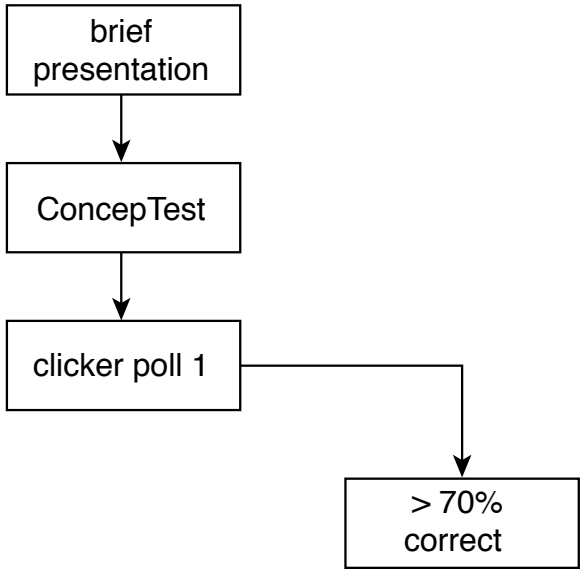
Peer Instruction: a primer



Peer Instruction: a primer



Peer Instruction: a primer



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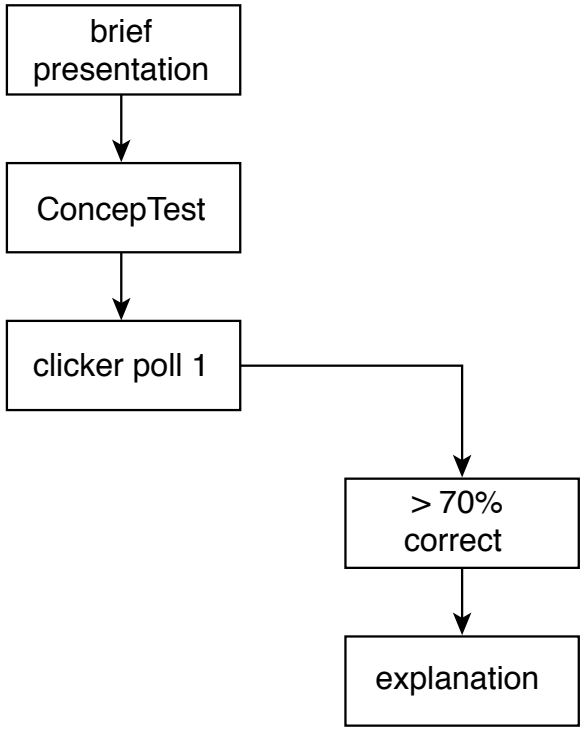
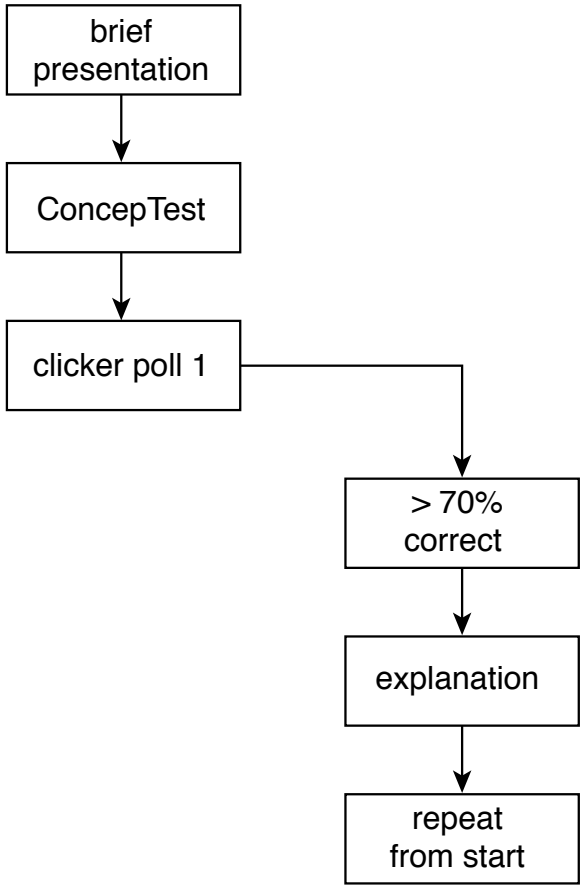


Peer Instruction: a primer



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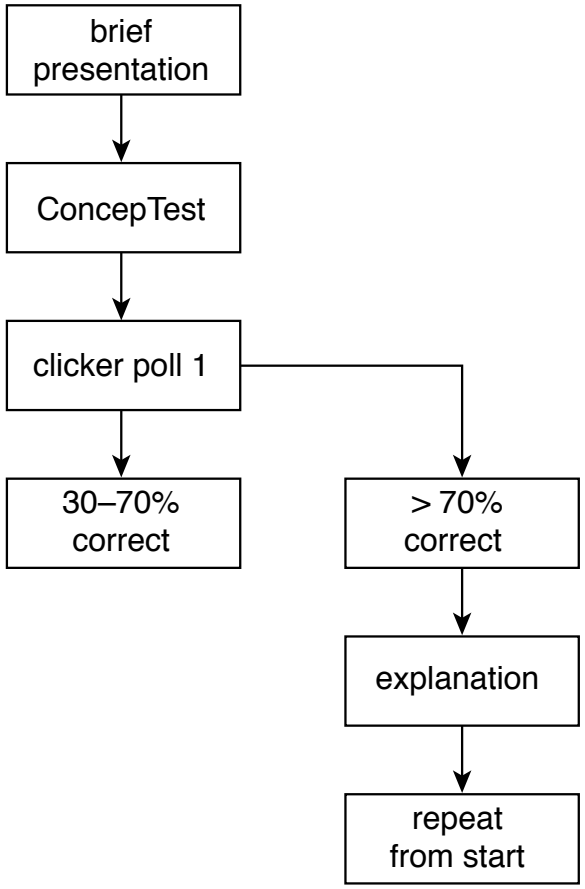
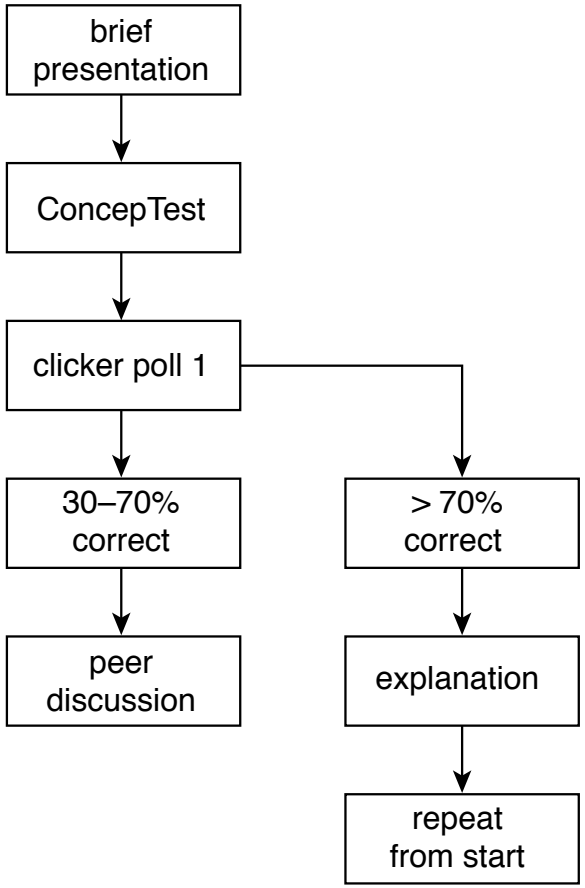
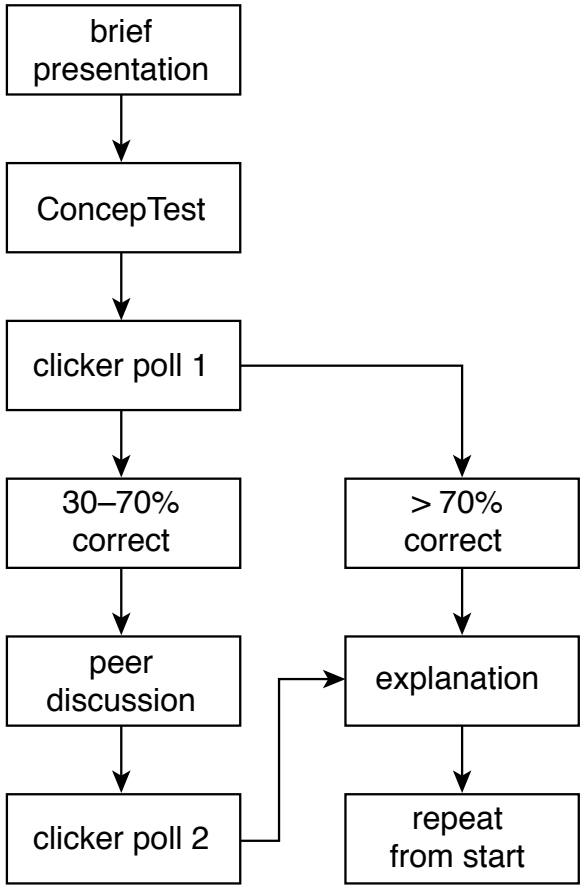


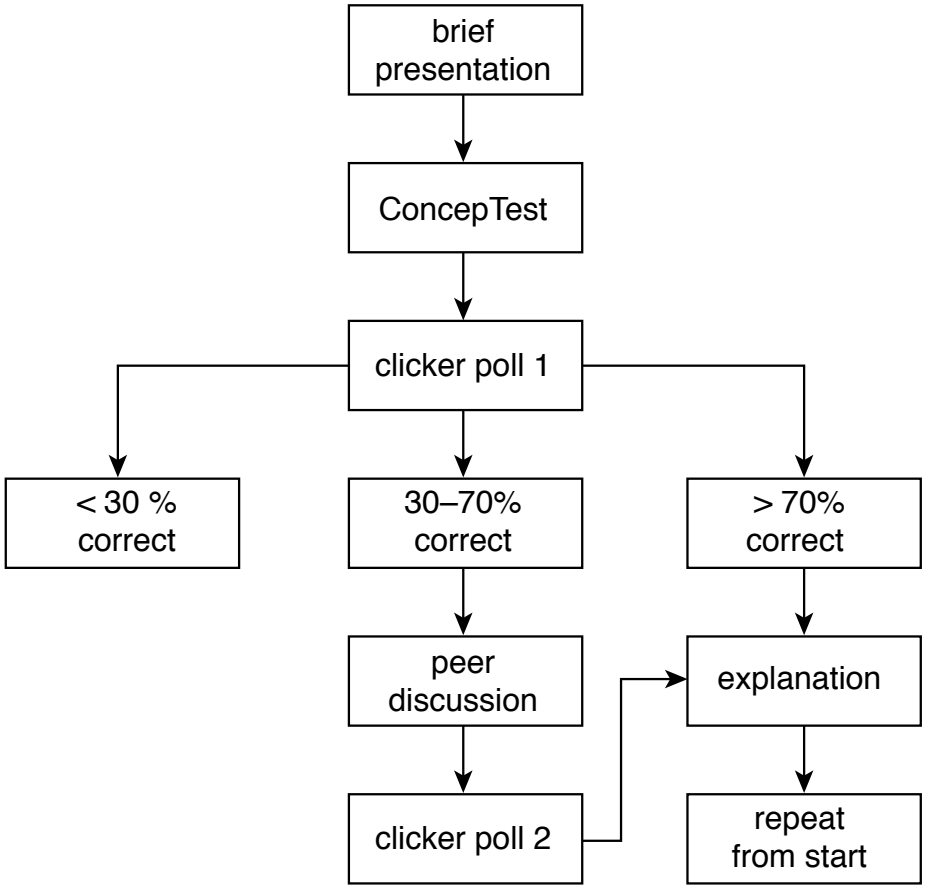
Peer Instruction: a primer



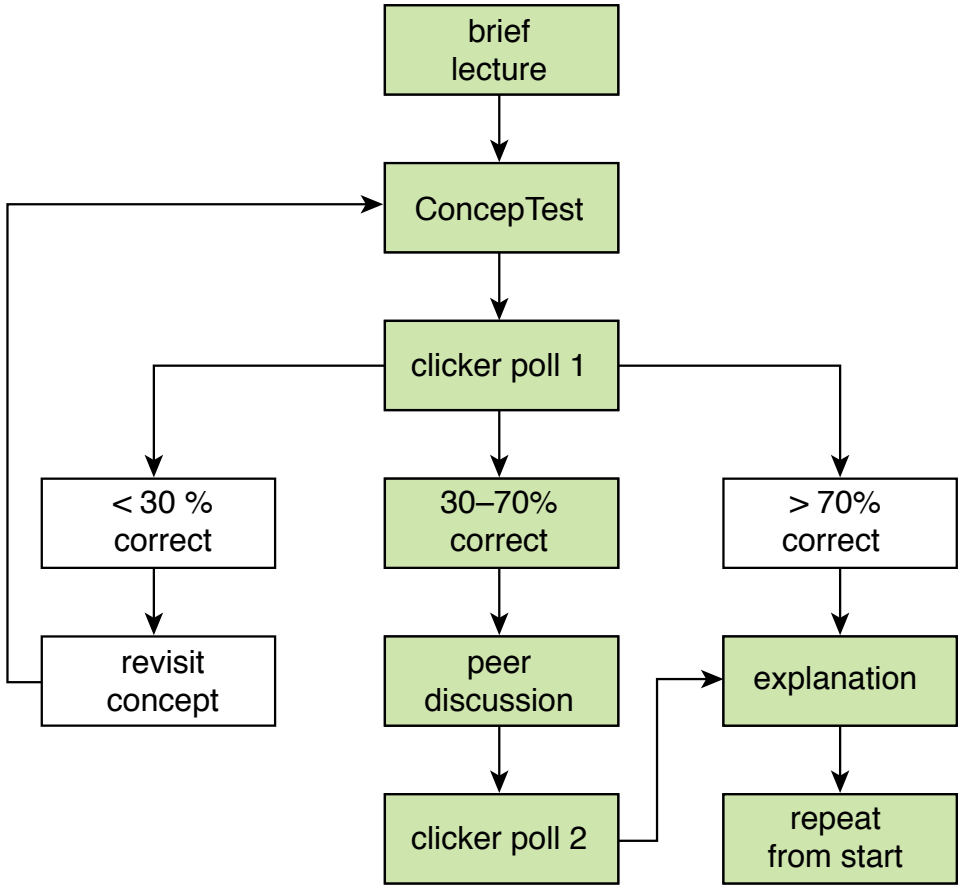
Peer Instruction: a primer



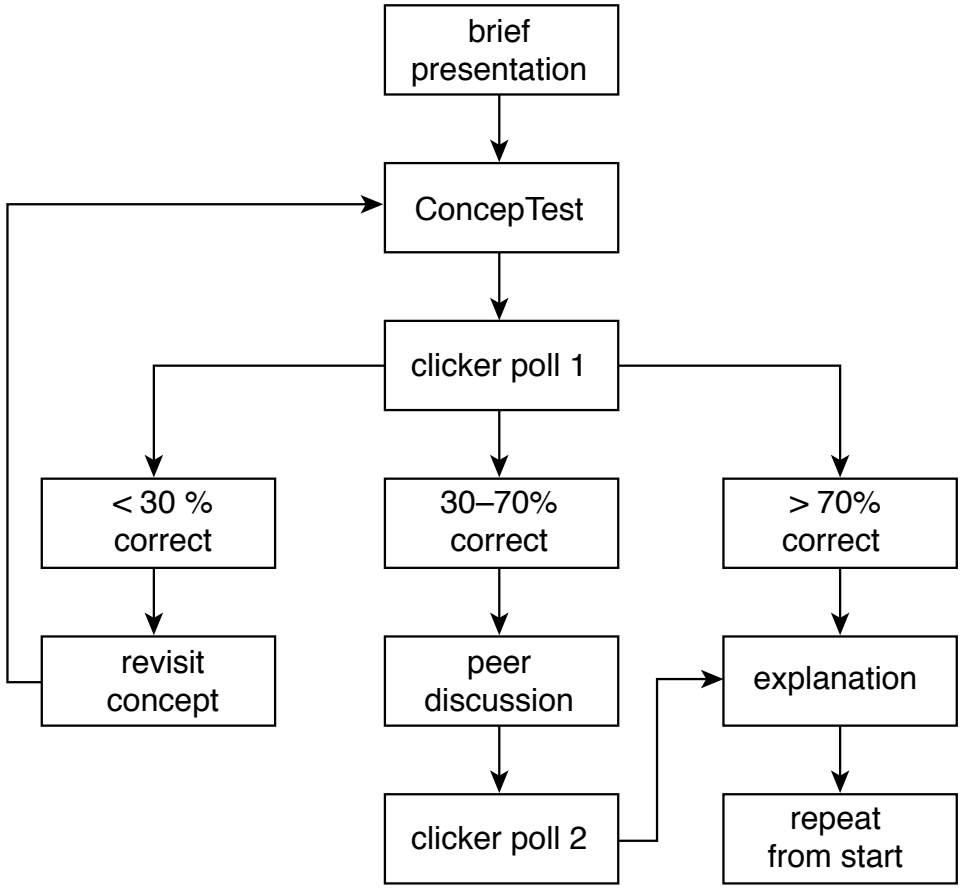
Peer Instruction: a primer



Peer Instruction: a primer

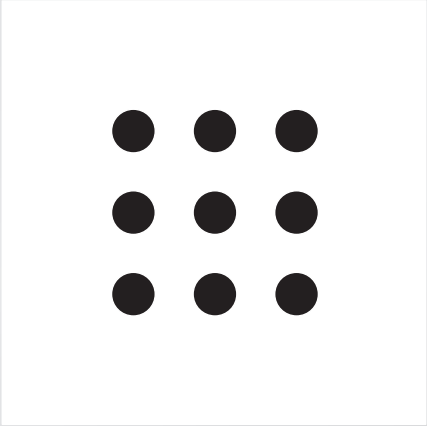


Peer Instruction: a primer



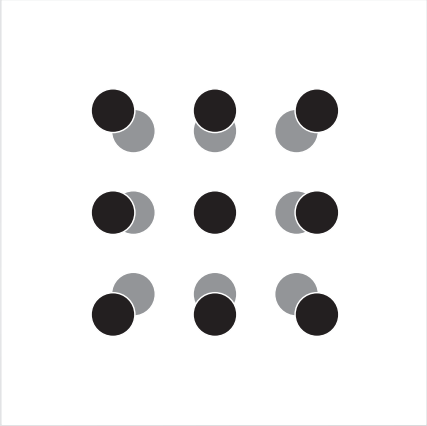
Let's try it!

When metals heat up, they expand because all atoms get farther away from each other.



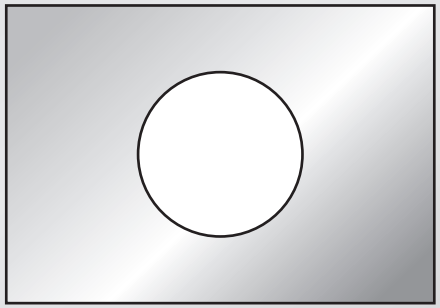
Let's try it!

When metals heat up, they expand because all atoms get farther away from each other.



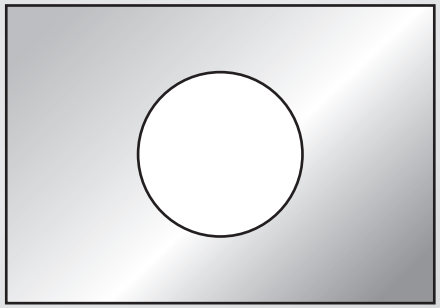
Let's try it!

Consider a rectangular metal plate with a circular hole in it.



Let's try it!

Consider a rectangular metal plate with a circular hole in it.



When the plate is uniformly heated, the diameter of the hole

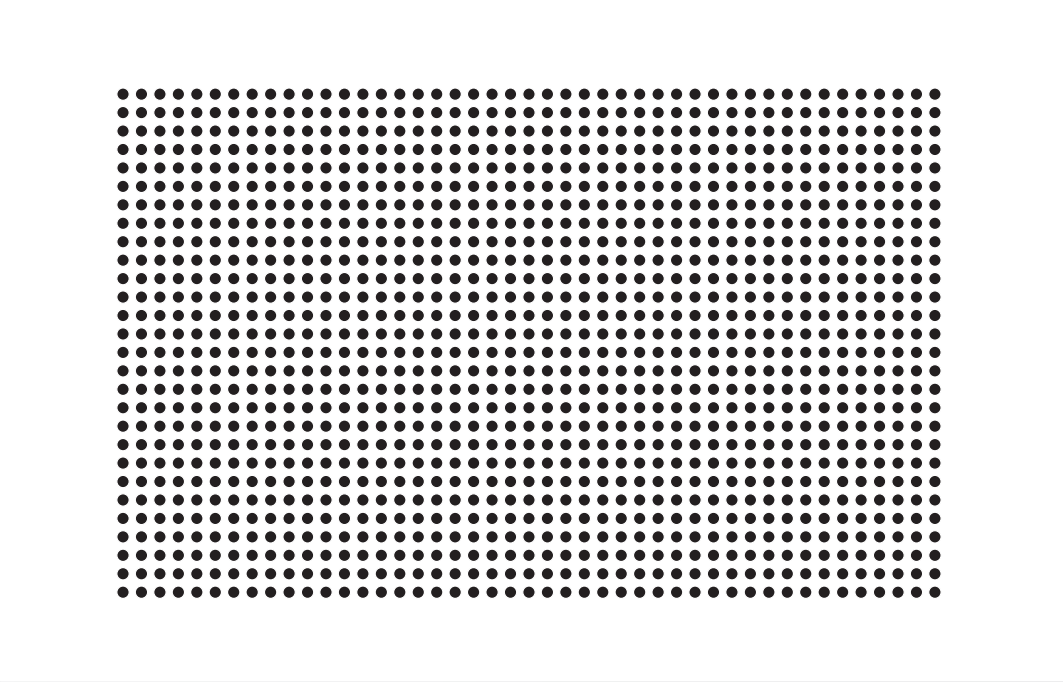
1. increases.
2. stays the same.
3. decreases.

Let’s try it!

It’s easy to fire up the audience!

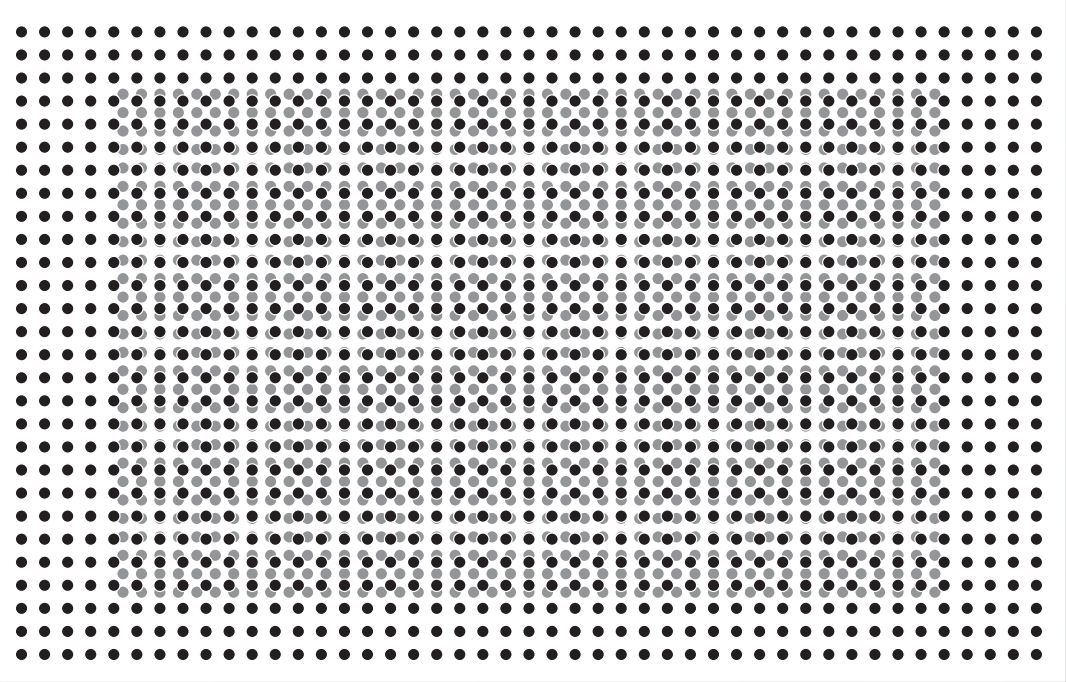
Let’s try it!

remember: all atoms must get farther away from each other!



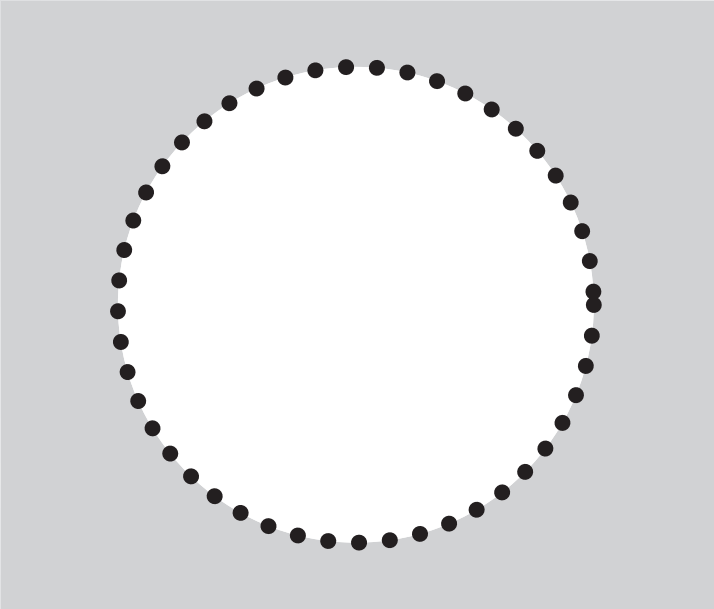
Let’s try it!

remember: all atoms must get farther away from each other!



Let's try it!

consider the atoms at the rim of the hole



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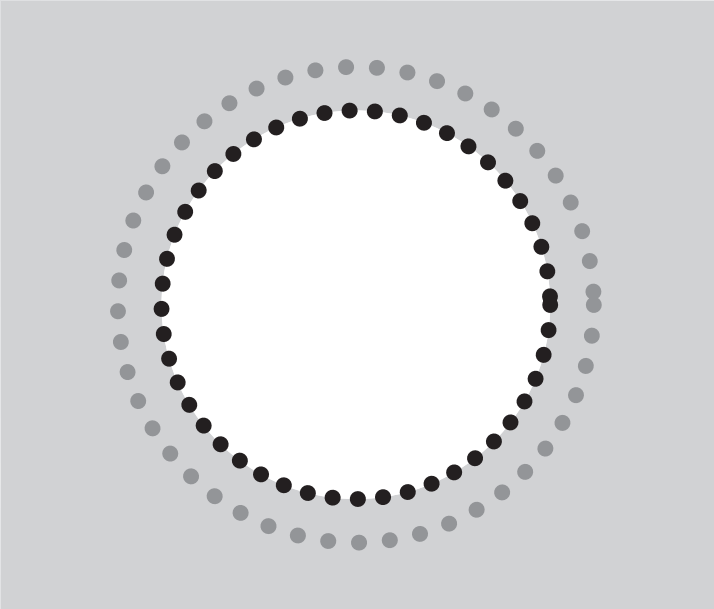

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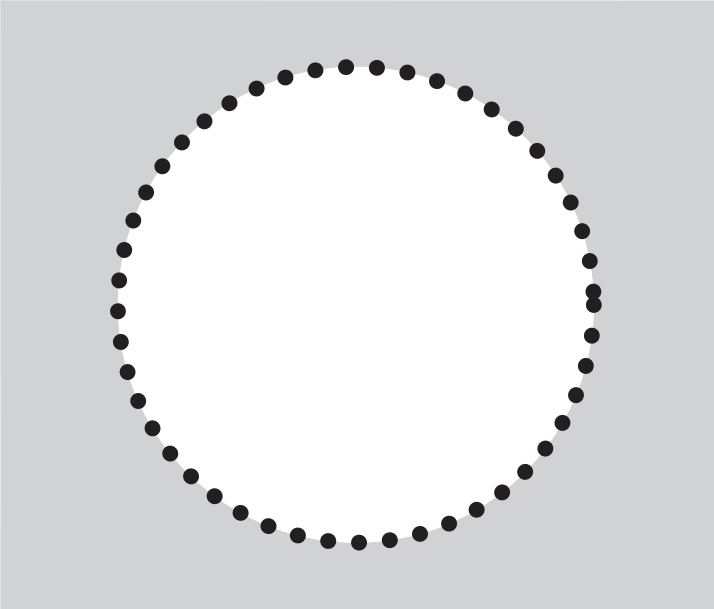

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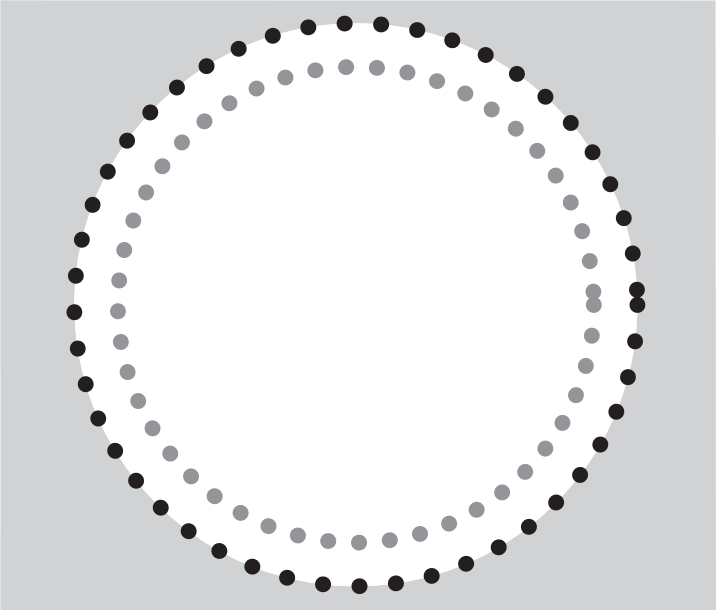

Setting the stage

What constitutes a good problem?

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

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How long do you have to wait before someone frees up a space?

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How long do you have to wait before someone frees up a space?

Requires:

Assumptions
Developing a model
Applying that model

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. On average people shop for 2 hours.

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Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?

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Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?

Requires:

Applying a (new) model

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

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How long do you have to wait before someone frees up a space?

$$t_{wait} = \frac{T_{shop}}{N_{spaces}}$$

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How long do you have to wait before someone frees up a space?

Requires:

Using a calculator

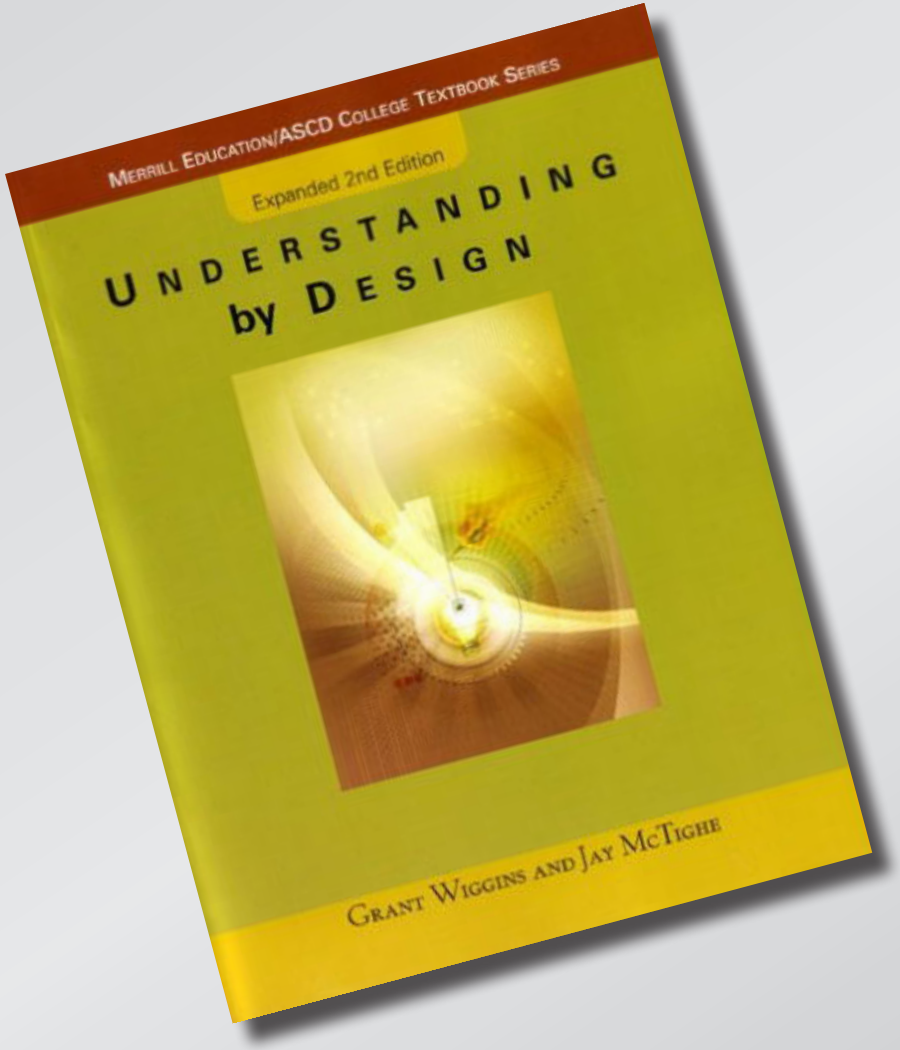
$$t_{wait} = \frac{T_{shop}}{N_{spaces}}$$

Setting the stage

Need to test meaningful skills!

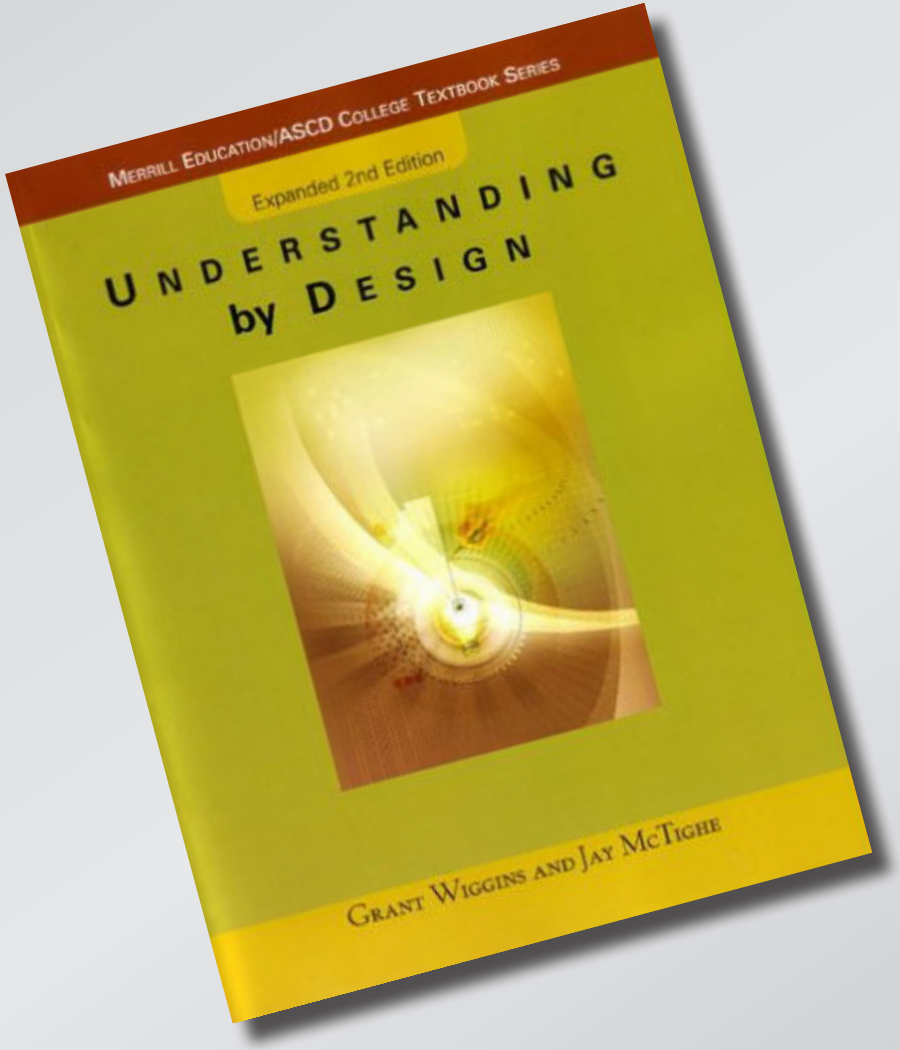
Setting the stage

Setting learning goals



Setting the stage

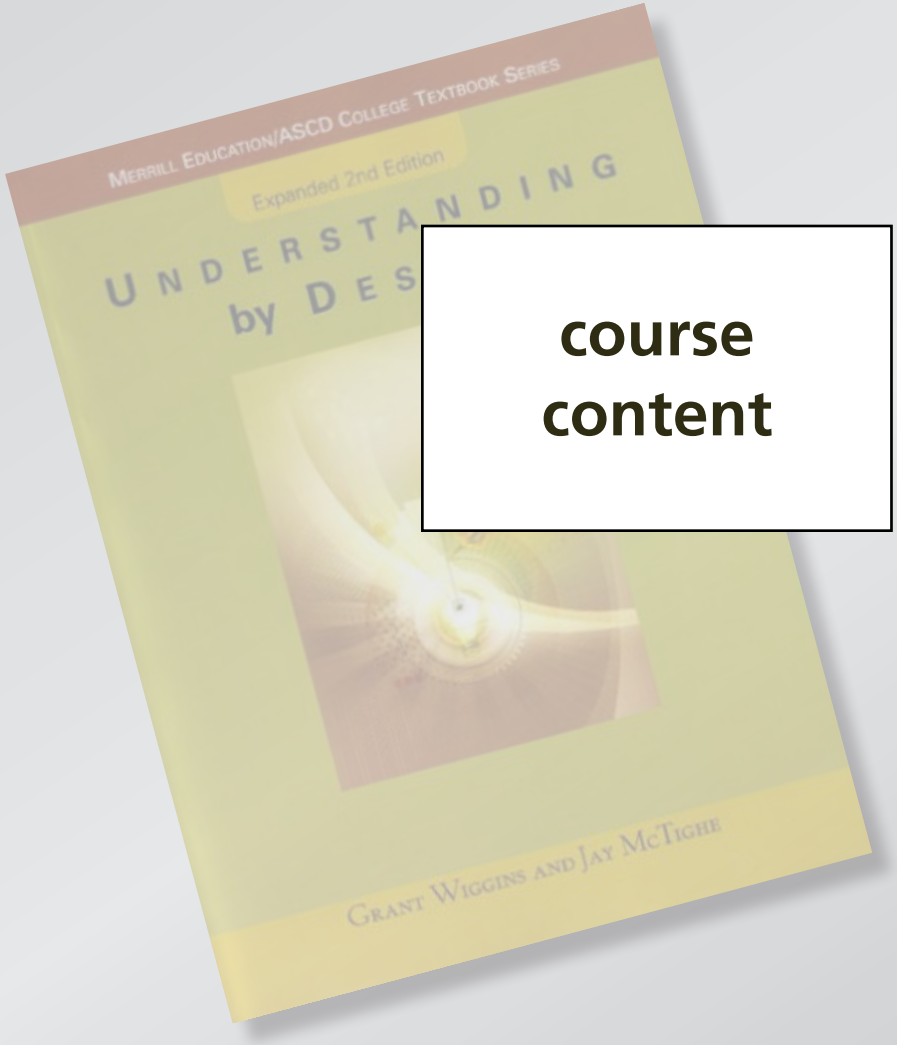
Setting learning goals



- approach, not content
- focus on understanding
- backward design

Setting the stage

Traditional approach to course planning



course content

Setting the stage

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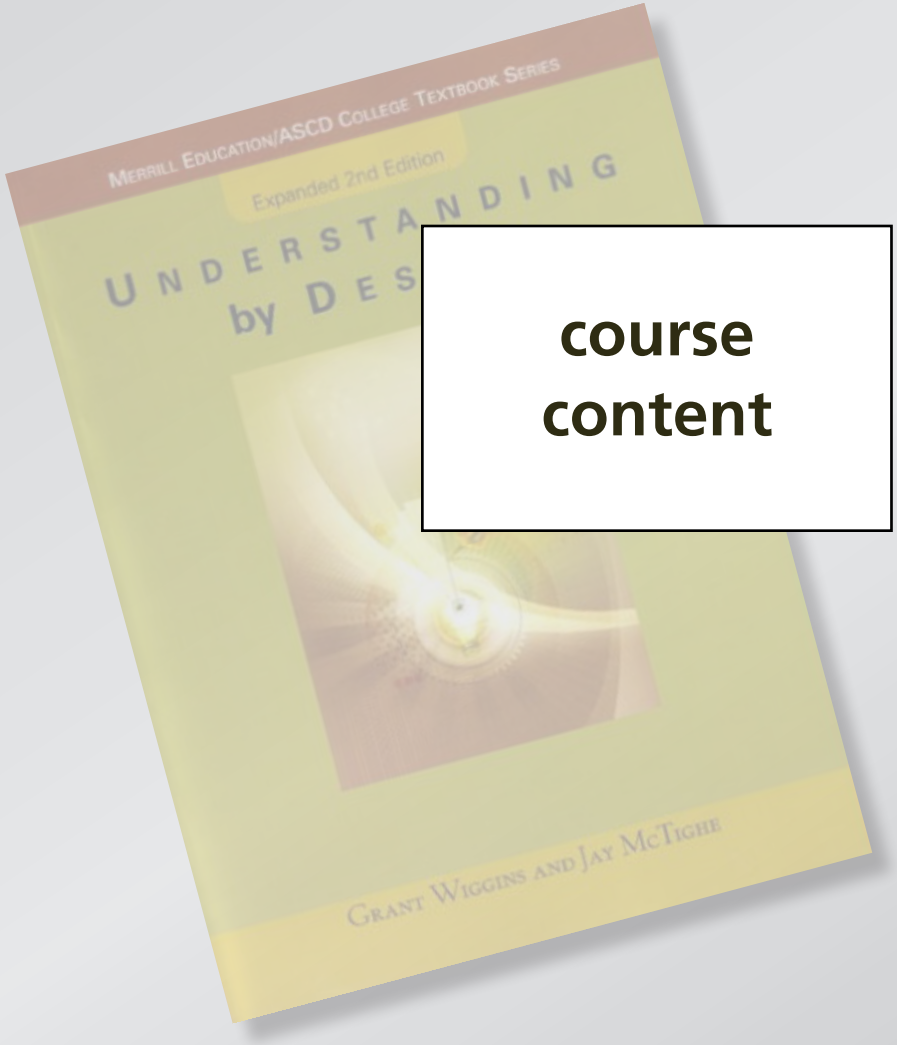
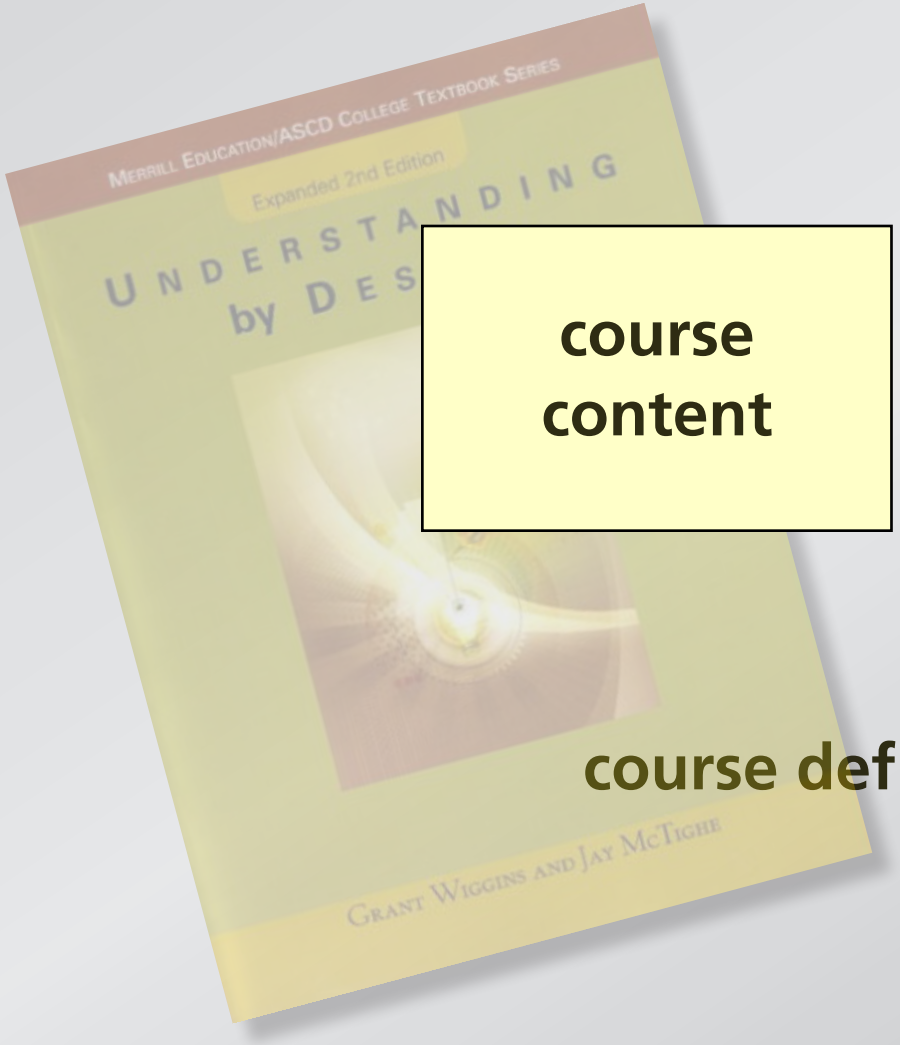


course content → assessment

Setting the stage

Traditional approach to course planning

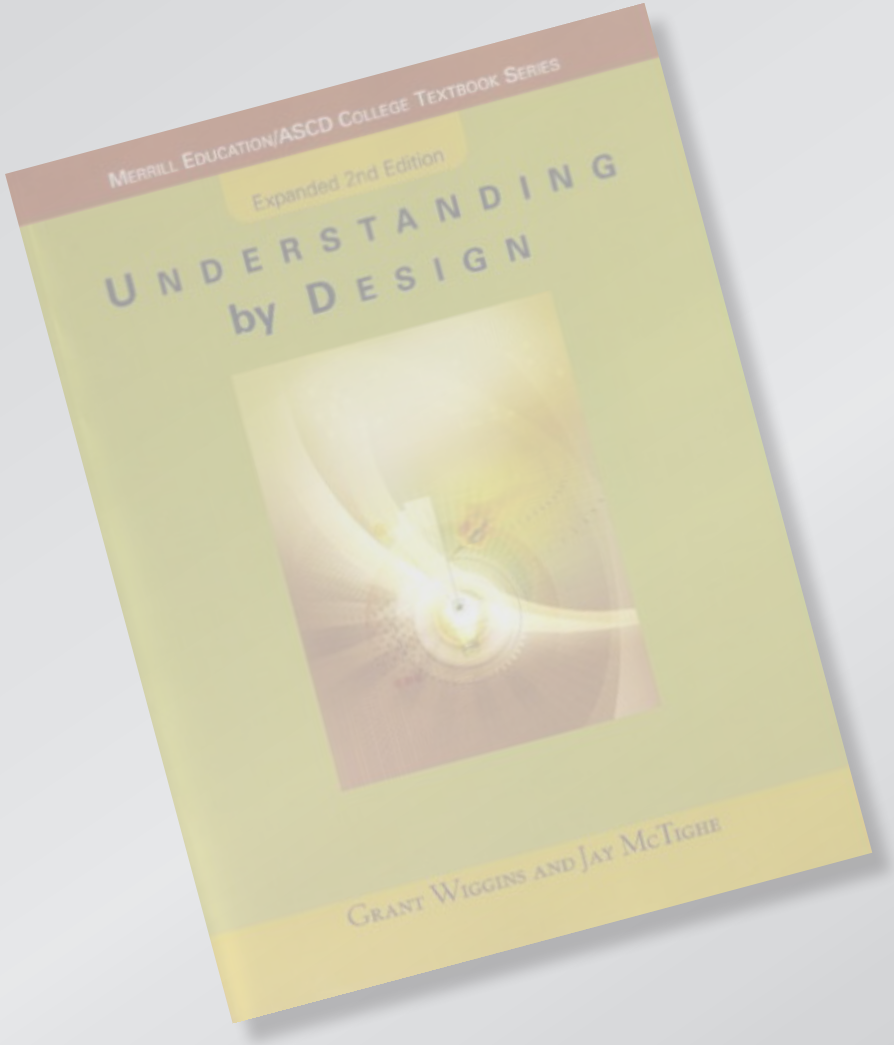


course content → assessment

course defined by content

Setting the stage

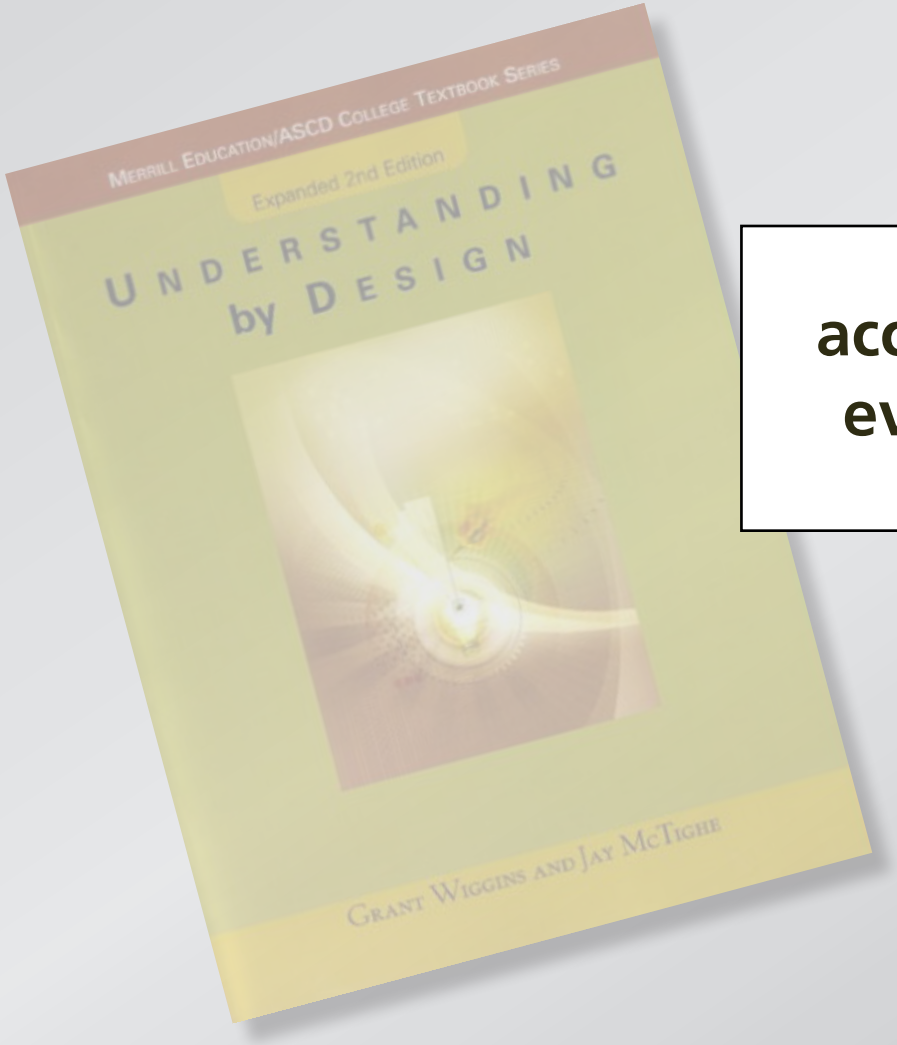
Backward design



desired outcomes

Setting the stage

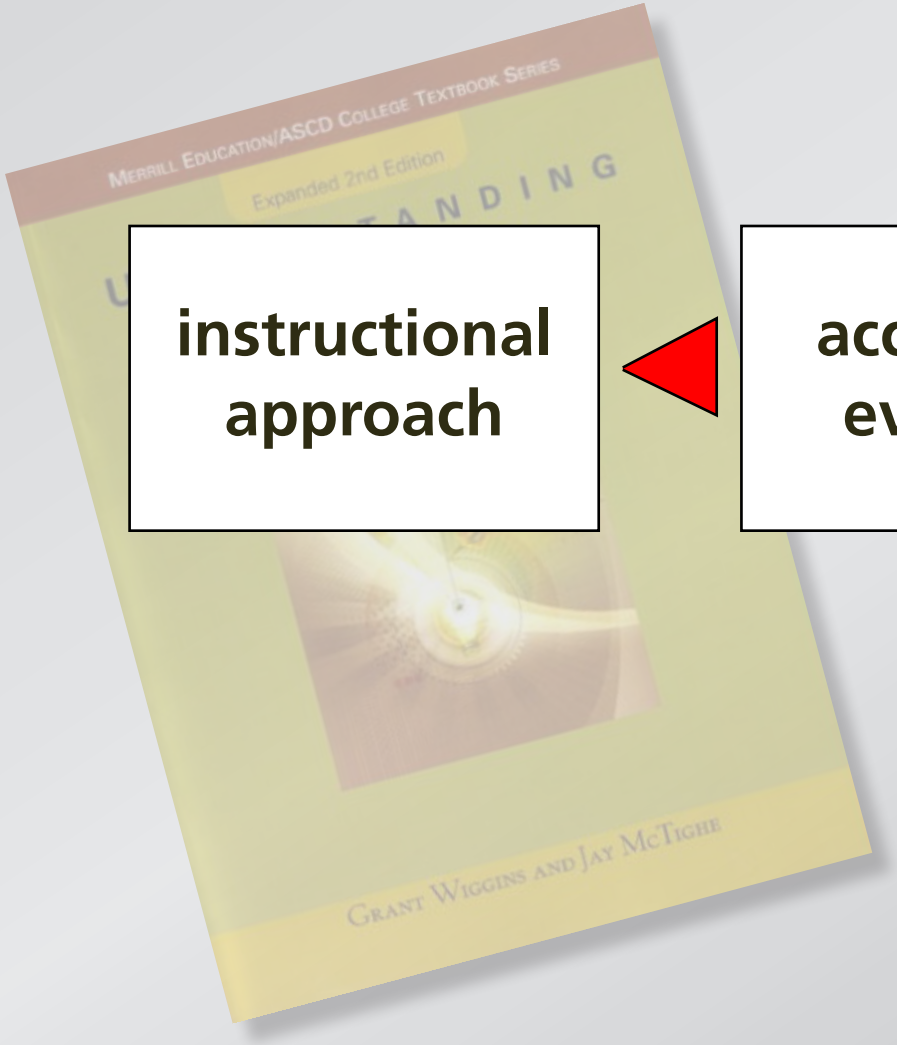
Backward design



acceptable evidence ◀ desired outcomes

Setting the stage

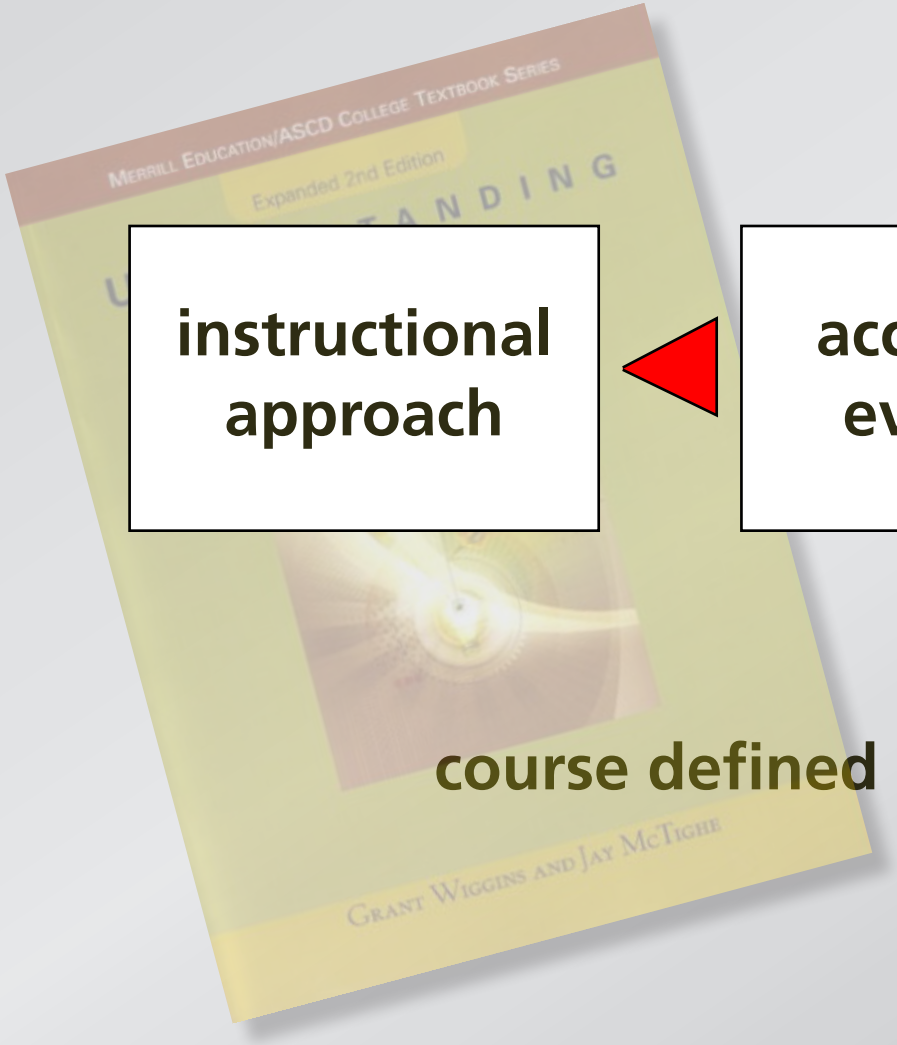
Backward design



instructional approach ◀ acceptable evidence ◀ desired outcomes

Setting the stage

Backward design

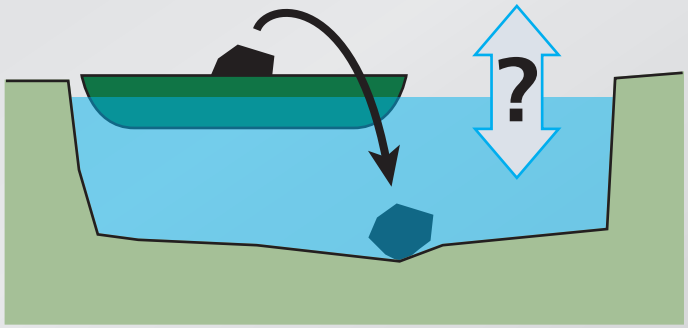


instructional approach ◀ acceptable evidence ◀ desired outcomes

course defined by desired outcomes

Let's try it!

A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.



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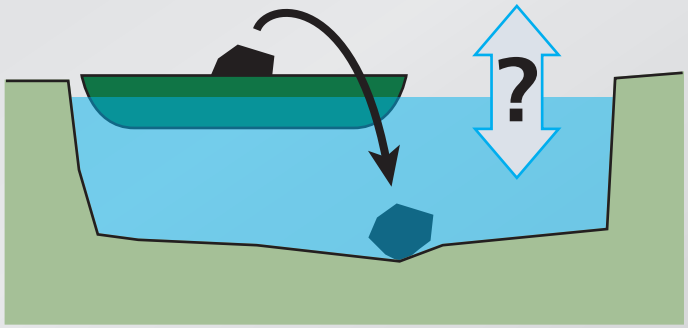

After the boulder sinks to the bottom of the pond, the level of the water in the pond is

1. higher than
2. the same as
3. lower than

it was when the boulder was in the boat.

Let’s try it!

We all make mistakes!

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